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VOLUME 1 / ISSUES 1 & 2

A PUBLICATION OF THE UNDERGRADUATE  
CERTIFICATE IN ENVIRONMENTAL WRITING  
AT THE UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN

THE

# RISING TIDE

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## The Editorial Board



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**From cover:** Floodwaters engulf an apartment complex during Hurricane Gustav on Sept. 1, 2008. Gustav's damage is estimated in excess of \$20 billion. Credit: A Cotton Photo.



The logo for Q Magazine, featuring a stylized white 'Q' inside a dark blue circular shape with a grainy, textured background, followed by the word 'MAGAZINE' in a clean, white, sans-serif font.

## Editor's note: Volume 1 print edition

Welcome to the debut print edition of *Q Magazine*, a showcase for outstanding environmental writing by undergraduates at the University of Illinois at Urbana-Champaign. Here you'll read about everything that's on our students' minds as they prepare to inherit a damaged Earth: climate change, extinction, the lack of fresh water, plastic pollution, and more. I know you'll be impressed with their serious grasp of these challenges, as well as the wit and ingenuity with which they imagine a better, sustainable future.

The articles in *Q*, richly researched and beautifully illustrated, are written for courses in the new Certificate in Environmental Writing at Illinois. The motto of these classes is "turning data into narrative" — designed for students to learn about the latest scientific research on the environment and how to communicate that research engagingly to the public. You can be guaranteed fascinating examples of just that in Volume 1 of *Q Magazine*. So, prepare to be informed and inspired by our Illini writers, reporting from the frontlines of a planet on the brink ...

### Gillen D'Arcy Wood


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### BIBLIOGRAPHIES

Our student authors put a lot of research effort into each *Q Magazine* piece. All sourcing for their articles can be found online at [q.sustainability.illinois.edu](http://q.sustainability.illinois.edu).

A photograph of a classroom during a discussion. Students are seated at long wooden tables, facing each other. Some are looking towards the front of the room where a professor is likely speaking. The room has white walls and large windows. A white text box is overlaid on the image.

Professor Gillen D'Arcy Wood leads a discussion in his ESE 498 class in Spring 2019.  
Credit: Jordan Goebig, Institute for Sustainability, Energy, and Environment

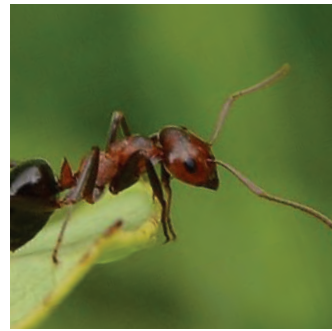
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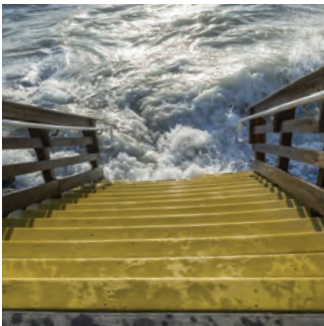
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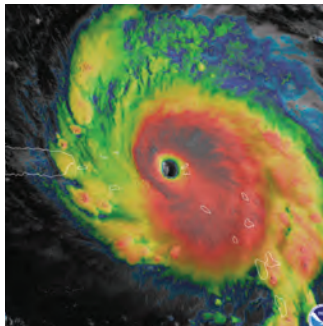
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# SOIL SOLUTIONS

By Katie Watson



Basalt application at the University of Illinois at Urbana-Champaign's Energy Farm. Credit: Jordan Goebig, Institute for Sustainability, Energy, and Environment

On the 320-acre Energy Farm at the University of Illinois, postdoctoral researcher Ilsa Kantola studies soil. She's interested in its chemical compounds, organic materials, acidity, and crop yield. With the help of a 16-person research team, powdered rock, and a little boost from chemistry, the field she's working on might soon be proof that agriculture — one of the biggest contributors to runaway atmospheric carbon emissions — could become one of its most unlikely solutions.

Each year, intensive agriculture makes up 14% of annual global greenhouse gas emissions. But, as Illinois Plant Biology Professor and project co-investigator Evan H. DeLucia explains, "one of the challenges we face as a society is that we can't just make dramatic reductions to our emissions. Since carbon dioxide (CO<sub>2</sub>) and greenhouse gases have such a long lifespan in the atmosphere, we have to come up with ways of pulling it down or absorbing it."

One method for absorbing excess carbon is a naturally occurring phenomenon called rock weathering, whereby carbon-rich rainwater reacts with rocks to form a carbonate precipitate. On its own, it's responsible for sequestering nearly half a gigaton of carbon a year. Applied on an industrial scale to farming, it has the potential to displace much more.

"The concept of integrating farming crops with rocks wasn't new; it's a process that's been used for ages," Kantola says. "But the idea that it could be used as a large-scale initiative to remove carbon emissions from the atmosphere? That's where we think there might be something."

For hundreds of years, rocks have been applied to crops to revitalize barren soils. Overused fields are more likely to have higher concentrations of metals — a hindrance to plant growth and soil fertility. If left alone, acidic soils can enter a downward spiral, becoming barren and incapable of producing any yield at all.

For generations, farmers have used crushed limestone on their fields to create a chemical reaction that restores acidity to the soil and promotes growth. But what if that reaction could be sped up to



expedite weathering — and do so in a way that displaces carbon?

Enter basalt, Earth's most abundant bedrock that also happens to be one of the most effective rocks when it comes to weathering.

At Illinois, the team is modeling agricultural fields to gain insight into basalt's effects on soil in the Midwest. By grinding basalt into a fine gray powder, its surface area is increased to maximize its reaction with rainwater. The crushed rock is then poured over fields of corn and miscanthus at a rate of 5 kilograms per square meter.

When water vapor and atmospheric CO<sub>2</sub> are combined, it creates a weak carbonic acid in rainwater. Then, when this water comes in contact with basalt, it jumpstarts a reaction with the soil and detaches the CO<sub>2</sub>.

From there, the CO<sub>2</sub> gets passed through the soil and exported into groundwater when it flows through the water cycle: into streams, rivers, and eventually the ocean where it will sink to the floor, out of sight. The bottom line: the Basalt Effect removes carbon from the atmosphere and sequesters it deep in the ocean.

"The main thing we're looking at is the rate of greenhouse gas production: both carbon dioxide and nitrous oxide (N<sub>2</sub>O)," Kantola says. "The added benefits to the crop's growing cycle is another bonus."

Through just a year of testing, the results of the research have yielded two major findings: (i) Basalt application is reducing N<sub>2</sub>O emissions, particularly from heavily fertilized cornfields; and (ii) grain yields are increasing.

"After our first year, these are just two results that make us want to do it again and continue the research process," DeLucia says.

But success is far from guaranteed: "When you're testing an idea, sometimes the downside is that you can't get anyone to adopt it even if the results work wonders," Kantola explains.

How to negotiate the tricky path from concept to commercial adoption? Farmers are already equipped to handle the rocky materials — they have the equipment and knowledge from years of using limestone on fields. Given farmers know how and when to use spreaders, as well as how it benefits their soil, the team isn't worried

about modifying their behavior. The main question on Kantola's and DeLucia's minds boils down to one not-so-simple factor: cost.

With the soil science argument made, economists must ultimately step in to determine if the project is feasible. The uncertainty regarding emissions and adoption will inevitably affect the future of the project. Will farmers be willing to pay?

"Economically, we're going to need to look into whether the benefits, potential carbon dioxide storage and higher crop yields, outweigh the costs of grinding up and transporting the rocks," DeLucia explains. "I've come to recognize that solving these big topics in sustainability are way outside any one discipline. For example, you need engineers and agronomists and economists working alongside plant biologists. It's not just up to one field of academics to solve these big problems. We have a responsibility to pool our knowledge and work together."

The Illinois project team is part of the Leverhulme Centre for Climate Change Mitigation (LC3M). As the five-year study continues, more data will become available that will help researchers make increasingly informed decisions and build a symbiotic relationship between farmers and climate scientists.

"What people fail to remember about soil is that it produces almost everything we need," Kantola says. "It grows food; it filters water. Our life is sustained mostly from this material we walk on."

Add to the list: a way to combat the warming of our planet.



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*One method for absorbing excess carbon is a naturally occurring phenomenon called rock weathering, whereby carbon-rich rainwater reacts with rocks to form a carbonate precipitate. On its own, it's responsible for sequestering nearly half a gigaton of carbon a year. Applied on an industrial scale to farming, it has the potential to displace much more.*





Living World



By Clarissa Ihssen

Photo Credit: NOAA

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A family fishing trip in Northern Wisconsin in 1970. Credit: Wikipedia

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hen at last I was old enough, I would go muskie fishing in the summers with my dad in the lakes near Hayward, in northern Wisconsin. Occasionally we would catch a special type of fish: the Northern pike. As my dad held the long, toothy predator over the side of the boat, he reminded me to be firm with the pliers. We didn't want the fish to experience

**Northern pike (*Esox lucius*) and muskellunge (*Esox masquinongy*) have a competitive relationship in the lakes of the upper Midwest.**

live — we liked to catch muskie, and everybody knew that if there were a lot of pike there weren't many muskie. We were doing the fish, and the other fishermen, a favor. Unfortunately, we were only half right.

Northern pike (*Esox lucius*) and muskellunge (*Esox masquinongy*) have a competitive relationship in

the lakes of the upper Midwest. Both are top predators that feed on smaller fish. Since pike are born earlier in the spring than muskie, for the first few months of their existence pike babies will eat muskie babies. Pike babies, called fry when just hatched or fingerlings when they have working fins and scales, will cannibalize other pike. This cannibalism used to be the main control of pike populations before we started bopping the adults on the head. Muskie fry are forced to go through the same cannibalistic population control while also being harassed by the pike fingerlings. Once this short but bloody numbers battle is finished, the two fish species go their separate ways.



Muskies typically grow to be 28-48 inches in length and can be up to 15- 36 pounds. Some of the largest muskies are caught in Northern Wisconsin. Credit: U.S. Fish and Wildlife Service

..... Or do they? Occasionally, the two species will hybridize and create what is known as the Tiger muskie (*E. lucius x E. masquinongy*), another large predator that is popular with both pike and muskie fishermen. Researchers have studied the hunting styles of each species, where each species prefers to live, and how to best increase muskie populations, but there is little scientific research on how the two species interact throughout their life cycles. Does having too many pike decrease the amount of muskie? That's a hard question. What number of pike is "too many"? What do we consider a substantial decrease of muskie? What if we're asking the wrong questions?

Management of natural resources is difficult: It is both a science in the true sense — we conduct experiments, perform studies, and analyze the results — and an art. Many wild populations follow a nonlinear dynamic. For example, populations of some predators and prey expand and

.....  
**(B)oth species of fish fulfill the same niche, but they are treated differently by the DNR — thus exhibiting a bias against the poor pike.**  
 .....

contract in cycles, such as wolves and bison, while other animal populations undergo sharp declines for no apparent reason. Because these dynamics do not follow a linear path, they are much harder to anticipate.

So it is for the celebrated muskie of Hayward. Northern Wisconsin has been a major destination for Midwest city dwellers

since the 1920s, lured by its rich fishing opportunities. In Hayward, plenty of activities and attractions are geared toward tourists. There's the Muskie Hall of Fame, which is shaped like a muskie with exhibits inside and a view of the downtown out of its mouth. There are shops for souvenirs, shows for nightly entertainment (including my favorite: the lumberjack competitions), while every year at the Muskie Fest vendors line the streets to hawk their muskie-themed wares. During fishing season, the town is filled with people and events. In the winter, the fishing off-season, it's a ghost town.

The majority of people who come to Hayward are there in search of the elusive muskie. To ensure a high population of muskie, a majority of the region's pike, perceived as a muskie nemesis, are killed. The current management policy, according to the Wisconsin Department of Natural Resources (DNR), is a daily bag limit of one muskie and up to five pike.

The practice of catch-and-release is encouraged to maintain population sizes, but to appease trophy hunters the DNR must allow some of the large predators to be bagged. Ecologically speaking, both species of

fish fulfill the same niche, but they are treated differently by the DNR — thus exhibiting a bias against the poor pike. If we kill five pike for every one muskie, the pike population will decrease at a faster rate than the muskie population. This is good for the tourists who come specifically for the muskie. But for the pike — and for the fish ecosystem at large — it is a potential disaster.

Anglers might think that they're doing the right thing by killing pike, but the "science" those anglers think they're following could be outright wrong. Just like when playing a game of telephone, the more facts are distributed from one person to another, the more likely information is to degenerate and interpretations become muddled.

Bottom line: We should be treating pike better in Wisconsin. In many places around the world, pike are valued for their size and their fight when on the hook, and their populations maintained accordingly. Pike are treated with inherent respect, rather than just as the ugly cousin to the muskie. We shouldn't be managing for one species over the other simply because one brings in more tourism. Instead, we should respect the role each fish plays in the northern lake ecosystem.

Pike and muskie aren't the only species we improperly manage because of outdated folklore "science" handed down by word of mouth. We mismanage wolf populations by purposely keeping their numbers low or nonexistent, which harms our white-tailed deer populations. Without their natural predators, the white-tailed deer is overpopulated, starving, and transmitting diseases within their herds. Likewise, out West, we mismanage bison populations because we are afraid of their transmitting Brucellosis to nearby cattle. Ironically, the reason that our native populations of bison

have this disease is because cattle spread it. We were not afraid of our cattle transmitting Brucellosis to other wildlife, which not only includes the bison but also elk, but we are now afraid of the reverse relationship.

Our mistakes in management include plants as well as animals. Many invasive plant species we're currently dealing with were intentionally planted by the U.S. government to feed birds (honeysuckle and buckthorn, for example) or to prevent soil erosion (kudzu). As with the muskie and pike of Northern Wisconsin, we didn't commission enough scientific studies to understand the complex interactions of these species and their ecosystem role. Too often, the problem of amateur resource management lies in the fact that we still listen to local wisdom based on "good" science of generations past, ideas that are no longer scientifically sound or good for the environment.

Now, when we go fishing on lakes in northern Wisconsin, my dad and I still want to be good stewards. We don't litter, we empty our boat's ballast before changing locations, and we leave the management of fish species to the scientists who spent their lives studying our favorite species — which is to say we no longer kill every pike we catch. Maybe we were being good stewards before, but because I don't spend all my time reading fish population literature and attending fishery stocking workshops, I am confident only of the fact that I don't know the best way to maintain a fish population. To better sustain our tourist economy and the complex inter-species interactions we don't fully understand is to leave ecological management to the professionals. We've come to Wisconsin to catch and release fish, so that's what we're going to do — and the pliers are only used to remove hooks.



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The Muskie Hall of Fame, which is shaped like a muskie with exhibits inside and a view of the downtown out of its mouth. Credit: Flickr

# Crawling With Ants

By Zack Fishman

I found myself in the kitchen one summer day, planning to grab just one more potato chip. As I opened the cabinet door on a bag of Lay's and some mild guilt, I noticed a speck of coffee grounds in the kitchen sink, an uninteresting sight — save for its rather uncharacteristic decision to climb up the porcelain wall. The curious phenomenon puzzled me for only a moment before I identified the speck, to my annoyance, as an ant. A colony of small black ants had been engaging in covert warfare against my house all summer by invading cereal boxes and sugar bags, but I caught this scout out in the open, hunting for leftovers. Postponing my snack duties, I closed the cabinet and grabbed a napkin to rid my home of another insignificant pest.

I was moving in to squash my enemy when the ant came into better focus. My napkinned hand hovering, it was no longer a dimensionless pest but a creature with a distinct body: its round head sporting harmless pincers, its thorax sprouting hairlike legs, its plump abdomen contrasting the otherwise sleek insect. As commonplace and meaningless as ants were to me, I suddenly stopped. The thought of squeezing the ant into an organic pulp made me cringe.

Why am I trying to end a life? I couldn't kill it, not like this. I put down my napkin, but I couldn't just let the ant escape into my pantry. Frantically looking for other options, I finally washed it down the drain and left both

the kitchen and my chips, distracted by a confusing moral dilemma.

If I really see no value in the ant, what stopped me from killing it?

**Is it size?** It's immediately obvious that no, I don't treat giraffes or whales significantly better than I treat my fellow, smaller humans, but there seems to be a hint of truth here. I pay no heed to the single-celled organisms that outnumber me beyond my comprehension, and I devote little more thought to ants and other small insects. Larger animals, like those that draw crowds at the zoo,



Credit: Flickr

capture people's attention and emotions much more strongly, but this seems to be more of a correlation than a direct reason; few people cherish lions or elephants because they are large. There must be something else.

**Is it intelligence?** Perhaps I instead find value in the intellectual capacity of life. Better cognitive function might mean greater complexity and ability, which are key features in humans. A look at a measure of intelligence used by some scientists called the encephalization quotient (EQ) seems to make some initial sense: Humans are unsurprisingly at the top of the list with an EQ of 7.4, followed by dolphins at 4.5, ravens at 2.5, dogs at 1.2, and so on. None of the animals on the list are small and ignorable like ants and amoebas, but the conclusion still rings hollow. Dolphins aren't valued four times more than "man's best friend," and who really cares for the clever raven over other birds? Intelligence is certainly closer to the truth than size, but the details don't pan out. Objective measurements might be the wrong approach for figuring out the how we emotional humans think about other creatures.

**Is it compassion?** Do I value animals I can emotionally relate with? It sure seems like it. Across the world, dogs and cats are closest to our hearts and homes, and we value them nearly to the level of other humans. People have buried their pets alongside other dead people for thousands of years, to take one example. Even beloved animals outside the home like pandas and monkeys are emotionally relatable, especially when they show human-like behaviors like yawning or playing. Ants just don't provide the same appeal.

And there's a scientific basis for my predisposition toward these relatable animals. We humans are very social, and both our survival and health have long depended on our relationships with our fellow humans. For this reason, we are excellent at reading the actions and feelings of other people. We're so good at it, in fact, that we read the actions and feelings of things that are not people, a phenomenon called anthropomorphism.

Eighteenth century philosopher David Hume described it artfully: "There is an universal tendency among mankind to conceive all beings like themselves. ... We find faces in the moon, armies in the clouds."

However, anthropomorphism is experienced most strongly when considering animals that more closely resemble humans. Generally speaking, we relate to mammals better than reptiles, and reptiles better than birds, and so on through fish and insects — indeed, aliens in movies are often given reptilian or insectoid features to achieve an off-putting "inhuman" appearance. While it isn't a perfect model of our preferences, a quick brainstorm of common pets (dogs and cats) and popular zoo animals (lions, monkeys, elephants, giraffes, and pandas) leads to nearly all mammals for this reason. Far from some physiological objectivity, our animal preference is much more personal: We like animals who look and act like us.

My initial discrimination against the kitchen-invading ant makes a lot more sense with anthropomorphism in mind. Despite this scientifically demonstrated tendency, however, I could feel a different instinctual force at play as I considered the physical act of destruction against the insect. There was something about crushing the ant's body, these functioning organs and their summation into this creature, that was simply disturbing to me.

I felt that I had a deeper connection to the tiny animal outside of the anthropomorphic bias. There was something about the ant's very act of living that compelled a sympathetic reaction from me. Some might call this reaction "biophilia," a concept formulated by ecologist E.O. Wilson that says humans have "the urge to affiliate with other forms of life."

According to Wilson, having a preference toward living beings is a genetic trait borne from evolution, explaining not only our bias toward mammals but also our love of colorful flowers and nature overall. Biophilia as a scientific hypothesis is currently unproven, but I believe it's a good starting point to understand my unexpected sympathy toward the ant.

As a being of high complexity, perhaps I see an intrinsic value in all life regardless of form that, like me, exists despite the entropic nature of the universe. Whether an evolutionary influence or simply a factor of being alive, I see some value or beauty in all living things of all scales. To demonstrate, imagine watching an amoeba through a microscope while using a blade to sever its cell membrane



And there's a scientific basis for my predisposition toward these relatable animals. We humans are very social, and both our survival and health have long depended on our relationships with our fellow humans. For this reason, we are excellent at reading the actions and feelings of other people. We're so good at it, in fact, that we read the actions and feelings of things that are not people, a phenomenon called anthropomorphism.

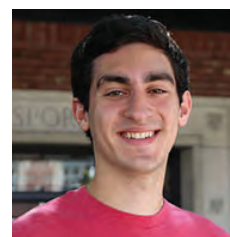
and seeing its translucent innards leak out in a depressing fading of life. I would feel a due proportion of guilt for such a death.

Killing the ant would similarly bother me on an emotional level. Even if the ant can't feel physical pain like I can — although the jury is out on whether it feels its own type — harming life often feels wrong, which is why I lowered my napkinned hand that summer day.

But I still washed the ant down the drain, away from its colony and into the sewage system where it very likely drowned. Regardless of the strength of my affection toward the crawling creature, there are practical limitations in place in order to live my human life. Certainly I can do nothing to save the billions of microbes both inside and outside of my body that die every day because of my mere existence. Even having the civilized bare minimum of a secure living space requires the disposal of harmful intruders, lest we allow nature to take over our homes.

While the moral treatment of animals is a difficult and complex subject, I'm inclined to say my actions were permissible. Ant colonies number in the tens of thousands, and many of its inhabitants leave the nest each day with the expectation that they will not return home. Death has already been built into the script of nature, such as my killing of the ant; despite my appreciation for the insect, we were at odds from the start. Humanity shares the Earth with 10 quadrillion ants, one species never able to defeat the other but always clashing at the boundary of our territories.

So, while I may feel more guilty for killing the ant than eating some potato chips, it is my role as a human to have human preferences and needs. Even with our current technology and understanding of the world, my life is filled with evolutionary forces and instincts that influence and justify my actions, including my eradication of pests to ensure idle snacks meet my taste, and cleanliness, expectations.



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CLIMATE CHANGE

THE

# DICIN

## TIDE

By David Marcus



FLORIDA IS AT THE FRONTLINE OF CLIMATE CHANGE, WHERE RISING SEAS IMPERIL 100 YEARS OF SUN-DAZZLED GROWTH. BUT LOCAL POLITICIANS AND DEVELOPERS CLEARLY HAVE THEIR HEADS IN THE SAND.



A major weather event in Miami floods out a film crew. Credit: Wikipedia

W

When I stepped out of my taxi in Fort Lauderdale, my foot landed in a puddle.

“Sorry about that,” my driver said. “Should’ve let you out on the other side. This street always floods around this time.”

He meant Fall, when South Florida experiences what are called king tides, the highest tides of the year. When the cab drove off, it left a pool of muddy water in its wake, the ripples cascading into themselves like miniature tidal waves. What I took to be a puddle was actually a long, shallow pond of water covering half the road. After standing at the curb for a while trying to work out the best way to cross, I realized that I had no alternative: My feet were going to have to get wet. I looked up at the sky, then down to my submerged feet.

#### **There is, I realized, no saving South Florida.**

I flew to Fort Lauderdale from Chicago to visit my Aunt Linda, who’s resided in the city on and off for 10 years. Now she was living in an apartment a few miles down the coast. After I’d crossed the road, found the entrance to the beach, and made my way down the wooden path, I saw Linda waiting on the sand. She wore a black beach dress.

“Hey sweetie! How’re you doing?” she greeted me happily, and we got to catching up.

I sat down after a while and dug my feet into the warm sand. I stared out into the Atlantic. She noticed the soaking wet pair of shoes laid beside me and laughed, a little sadly.

“ When I first started coming here 30 years ago, there was about 50 feet of beach between where we’re sitting and that ocean. Look at it now. It’s maybe 20 feet. ”

### STORM SURGE AND HIGH TIDES MAGNIFY RISKS OF LOCAL SEA LEVEL RISE



As sea levels rise, coastal cities will become more vulnerable to storm surges.  
Credit: Union of Concerned Scientists 2015



“When I first started coming here 30 years ago, there was about 50 feet of beach between where we’re sitting and that ocean,” she said. At that moment I noticed the leanness of this beach, the gentleness of its slope into the impassive blue water. “Look at it now. It’s maybe 20 feet.”

That number — 20 feet! — hung like a hooked shark in the tropical air, converging in my mind with the flooded road behind me and the encroaching ocean ahead. Linda had been thinking it, too: The water was rising in Fort Lauderdale, just as it was across Florida and all up the Atlantic seaboard. A direct result of human reliance on fossil fuels, sea level rise is entirely predictable, and on track with scientific projections. Our production of greenhouse gases, especially carbon dioxide, prevents a portion of the sun’s heat from reflecting back into space and traps it in our planet’s atmosphere, thereby warming the Earth. This increase in temperature leads to the melting of ice sheets and glaciers. It also causes oceans to increase in size as they absorb the reflected heat, since water expands as it warms.

This thermal expansion, combined with land-based ice melt, is projected by the most recent Intergovernmental Panel on Climate Change (IPCC) to lead to a sea level rise of at least 3 feet by the end of this century. However, this projection, which assumes that the rate of ice melt won’t accelerate as the Earth warms, is actually rather conservative. Other organizations forecast more perilous scenarios. The U.S. Army Corps of Engineers — not exactly a radical organization — predicts a rise of up to 5 feet, while the National Oceanic and Atmospheric Administration (NOAA) projects up to 6.5 feet.

Some in the scientific community fear more extreme scenarios. Prominent Miami-based geologist Harold Wanless, for example, foresees a sea level rise of 10 feet or more by century’s end. No matter how successfully we reduce carbon dioxide (CO<sub>2</sub>) emissions, we are already locked into this sinking future, in which seas will continue to rise for centuries to come. According to Climate Central, a nonprofit research and news organization, even if we were to keep global temperature rise below 3.6 degrees Fahrenheit, as the Paris Agreement specifies, sea levels may still rise 20 feet or more over the next several hundred years.

In this dire scenario, nearly 300 U.S. cities will lose at least half of their homes by 2100, and 36 cities will be lost entirely. Yet even the lower-end projection of a 3-foot rise in sea level will wipe away coastal communities around the globe and inundate cities like Fort Lauderdale and Miami.

Long before those cities are submerged, however, they’ll experience chronic daily flooding. Puddles won’t just

soak tourists’ shoes. Streets will be too flooded to drive through, and water will rise from beneath the ground. The Union of Concerned Scientists estimates that Miami-Dade County will suffer roughly 380 high-tide flooding events per year as soon as 2045. By that time, living in Miami, Fort Lauderdale, or anywhere else in South Florida will be nearly impossible.

For a city, state, and — by extension — country at such great risk, frighteningly little planning exists in the United States for this magnitude of sea level rise. Though the majority of Americans believe the climate is changing, many remain blind to the immediacy of the problem or expect that some god-sent technology will save us. We continue to live with our heads in the sand as the water inches up to our necks. In reality, there is no debate: South Florida is lost. The only question that remains is how we will plan for its demise.

## DENIAL

After an hour of hanging out at the beach, Linda and I walk back to her apartment.

“It’s a nice, old building I found with your grandma,” she said, as we walked along the same spot where my cab dropped me off. “Oh man — whooh!” Linda said, “Watch out for that that water! The neighbors are great; you’ll love it. I’ve got an air mattress all set up for you.”

The place was 15 minutes down that same road, the right side of which was lined with modest, four-story condos that looked like they were owned mostly by retirees. As we walked along, the public beaches on the left side became fenced off, and then replaced by massive, 20-story apartment buildings, each one more modern and lavish than the last. Soon, I could barely hear the ocean nearby, the breaking of the waves muffled by passing cars.

“They just finished construction on that one last year,” Linda noted, catching me staring at one particularly opulent development, a cylindrical, enormous building with an Aston Martin parked in front. “They’re always building something new around here.”

These days, Fort Lauderdale’s compact downtown is in the midst of a development boom. According to the city in 2017, almost 9,000 residential units and 900 new hotel rooms have been built, are being built, or have been approved for construction since 2012. All this despite the fact that nearly a million Florida homes worth more than \$400 billion are at risk of being submerged by 2100.

Apparently unconcerned with sea level rise, developers continue to build along Florida’s coastline, and as long as

“ Last time I was in Miami a year ago, I saw streets flooded outside people’s homes. There wasn’t even a cloud in the sky — it was warm and sunny, and the streets were so flooded you had to wear rain boots to walk through them. ”

buyers remain hungry for properties, there’s no reason for the boom to end. Plus, developers have local governments on their side, which need high-end properties to help pay for defending shorelines.

This is especially the case in Miami. The more sizable and expensive condos there are in the area, the more taxes and fees Miami Beach can collect and use to fund anti-flooding projects — at least, that’s Miami’s half-baked plan to outbuild sea level rise. While the move makes sense for a state with no income tax, building more property to raise money to defend property is an absurd recipe for disaster. Yet this about marks the extent of the planning that Florida has done for sea level rise. Most of the time, developers and legislators keep busy pretending the beaches aren’t being swallowed by the sea.

“Last week I met a friend for lunch at this popular place, the Pelican Grand Reef Resort,” Linda says, “and there was barely any sand between where we were sitting and the water. Every one of these hotels and condos are losing their beaches. They wouldn’t have any beaches at all by now if they didn’t constantly bring in sand from offshore.”

By trying to bury their problems, developers mask the extent of the sea level rise predicament and do their best to keep up appearances. In doing so, they merely construct an increasingly lavish stage for the tragic final act of South Florida’s inundation.

The politicians presiding over Florida’s future promote a similar business-as-usual mindset. U.S. Sen. Marco Rubio, R-Florida, the former Chairman of the Subcommittee on Oceans, Atmosphere, Fisheries, and Coast Guard, has said that, since he is not a scientist, he is unqualified to have an opinion on humanity’s role in climate change. Then-Florida Gov. Rick Scott, a fellow Republican, is equally skeptical about the human role in sea level rise, openly stating that he does not believe the climate is changing. Charlie Crist, Scott’s Democratic predecessor, made sea level rise a key issue during his tenure — and even called climate change one of the most important issues of the century.

But since the election of Scott, Florida has swung back to the denial camp. According to a report by the Florida

Center for Investigative Reporting (and noted in sea level rise expert Orrin Pilkey’s book, *Retreat from a Rising Sea*), employees of the state’s Environmental Protection Agency have been ordered not to use the terms “climate change” or “global warming” in official communications. Though some forward-minded Floridians, such as South Miami Mayor Philip Stoddard, openly discuss the dangers facing their state, meaningful action is hard to achieve so long as the state and federal governments outright ignore the threat.

In a twisted way, one could argue that state politicians, as well as developers, are doing what’s best for Florida in the very short term. If they admit that beaches are disappearing and that roads are flooding, they acknowledge the existence of a threat that imperils the very future of their state. Property values will fall. Banks will stop writing mortgages. Condos will stop selling as the wealthy buy homes elsewhere. Residents will become anxious and start trickling out of the state, leaving behind unsellable homes. To avoid that eventuality for as long as possible, state politicians will likely turn a blind eye to sea level rise, ensuring that when South Florida can no longer ignore the catastrophe, its response will be haphazard and long overdue.

Yet Florida’s self-inflicted tragedy extends beyond the bounds of individual politicians and business interests. Climate change (and, by extension, sea level rise) has been called the ultimate wicked problem in that it endangers the entire planet while simultaneously exposing how poorly equipped we humans are, cognitively and politically, to manage a threat of precisely this complex, planetary character.

The consensus among climate advocates is that only long-term planning will save the global human community from the worst consequences of climate change. But the abbreviated timeframe of electoral politics that produces the likes of Rubio and Scott leads to nothing but short-term “solutions” to these long-term, systemic problems. Politicians promise to install more pumps, raise roads, and restore wetlands, even as the true extent of the threat goes unacknowledged and boom-time construction churns on mindlessly.

In reality, there is only one productive way forward: a frank discussion of the full gravity of the threat from the sea. Many Floridians will fight the hard truth of sea level rise by putting their faith in doomed-to-fail engineering projects. For instance, in response to frequently flooded streets, Miami Beach recently installed pumps that push water back into the Biscayne Bay, a lagoon south of Miami. The pumps manage to keep some neighborhoods dry during king tides; but streets still flood during rains.

The bigger problem is scale. While the pumps might work for Miami Beach, a city just eight square miles in size, in terms of energy expenditure, cost, and sheer feasibility, pumps could not possibly be implemented throughout South Florida. It would be akin to trying to hold out the entire ocean with pumps. Floridians might turn to other engineering solutions, such as sea walls. Designed to hold back the ocean and prevent shoreline erosion, a well-built wall will indeed fix the boundary between land and sea. Yet even the best constructed sea walls are not invincible. Over time, as waves erode the sand or soil anchoring a wall at its base, barriers become susceptible to collapse. Subsequently, one could imagine how even a perfectly constructed sea wall would need to be increased in height continuously as sea levels rise, and would cave under its own weight eventually.

Regardless, sea walls will probably never be constructed along Florida's coast for the simple reason that residents will never consent to lose their beaches. Beaches are the hallmark of Florida; they provide residents with quick access to the ocean and bring in billions of dollars worth of tourism every year. They are the very essence of Florida life, and most residents would sooner leave than lose their beaches to giant, costly, and ugly sea walls.

## DANGER FROM BELOW

Even if one continuous, indestructible sea wall were to be constructed along the entire 1,350-mile-long Florida coastline ... even if the state were outfitted with an army of dikes, water pumps, levees and walls ... Florida still cannot be saved from the rising tide.

The doom of the Sunshine State is sealed by two words: porous limestone.



Normal Miami Beach flooding during king tides. Credit: Miami Herald

Picture a 40-foot-thick layer of sponge made of stone beneath the ground. That is what underlies most of South Florida, including Miami and Fort Lauderdale. The remains of sand grains and the skeletons of tiny plantlike animals deposited in shallow water 125,000 years ago, Florida's limestone is very porous, i.e., full of little holes. This means that fluids can move through the many interconnected pore spaces with ease. In fact, the limestone beneath South Florida is so permeable that the water levels of some ponds in Miami actually rise and fall in concert with offshore tides.

The geological significance of this limestone to South Florida's future cannot be overstated. Like a scene from an apocalyptic movie, the water will literally come up from underground. Because of the certainty of this inundation, Pilkey writes in *Retreat from a Rising Sea*, Miami is more threatened by sea level rise than any other major city in the United States. Its greater metropolitan area has a population of 5.5 million, billions of dollars' worth of real estate, and hundreds of schools, hospitals, power plants (two of which are nuclear), sewage plants, landfills, and hazardous material sites that stand at risk of flooding.

Even before the Atlantic overtakes the city completely, freshwater flooding will become an increasingly chronic

problem for residents. Built on lands that were formerly Everglades, South Florida is as flat as it is low, and would flood after rainfall events if not for the 2,300 miles of canals that redirect floodwater to the Everglades and the ocean. When the canal system was implemented half a century ago, its builders quickly realized the potential for storm surges to push seawater up the canals into the interior of the state. Consequently, flood control



Flooded streets of a residential neighborhood in Fort Lauderdale, Florida. Credit: Shutterstock

Waves overtake the beach in Fort Lauderdale, Fla. Credit: NASA Jet Propulsion Laboratory



gates were built to prevent the salinization of freshwater sources. The logic went that the gates could be closed whenever a storm threatened in order to halt saltwater intrusion. When closed, the gates do just that, but they also stop the canals from draining rainwater and have the potential to flood the region from within. In the years since the floodgates were constructed, local sea level has risen by 5 to 8 inches and multiple gates have become unable to discharge stormwater runoff during high tides.

According to Leonard Berry, Director of the Florida Center for Environmental Studies, just 6 more inches of sea level rise may cripple nearly half of South Florida's flood control capacity. As sea level continues to rise and inundate land, Pilkey concludes that more floodgates and, eventually, the canal system itself, will be rendered useless. Sea water will reverse the flow of the storm drains, and there will be nowhere for freshwater, or sewage for that matter, to go.

This flow reversal has already begun in Miami, where water often pours from the storm drains onto the street when tides are high.

"Last time I was in Miami a year ago," Linda told me as we strolled along the beach, "I saw streets flooded outside people's homes. There wasn't even a cloud in the sky — it was warm and sunny, and the streets were so flooded you had to wear rain boots to walk through them."

According to the Union of Concerned Scientists, residents of Miami Beach can expect to experience flooding more than 230 times a year within two to three decades. Because of all that backed-up sewage, the floodwaters that will spill from storm drains into the streets are going to give off a strong smell of human waste. When freshwater flooding isn't a problem, obtaining freshwater for consumption will be. As sea level rises, salinization will deplete South Florida's freshwater supply, which is stored in the form of groundwater and drawn from the Biscayne aquifer.

In fact, saltwater has already contaminated much of the groundwater along the state's coast. Because the sea has intruded into its freshwater wells, Hallandale Beach, a city north of Miami, is moving its entire drinking water supply westward. Pilkey thinks more wells could theoretically be relocated farther away from the ocean, but it would only

be a matter of time before those sites become salinated, too. As the end of the Florida Dream draws near, porous limestone, a soon-to-be ineffective canal and floodgate system, and salinated groundwater will combine to render Miami and its surroundings uninhabitable. This doesn't even take into account the increased intensity of storms and higher storm surges that will result from rising seas. By the midpoint of this century, if not sooner, Miami, Fort Lauderdale, and every town in South Florida will be a salty, wet marsh on its way to being swallowed by the ocean entirely. Miami mayor Stoddard puts the situation bluntly:

"Another foot of sea-level rise will be enough to bring saltwater into our freshwater supplies and our sewage system. ... You won't be able to flush away your sewage and taps will no longer provide homes with fresh water. Then you will find you will no longer be able to get flood insurance for your home. Land and property values will plummet and people will start to leave. Places like South Miami will no longer be able to raise enough taxes to run our neighborhoods. Where will we find the money to fund police to protect us or fire services to tackle house fires? Will there even be enough water pressure for their fire hoses? It takes us into all sorts of post-apocalyptic scenarios. And that is only with a 1-foot sea level rise. It makes one thing clear, though: Mayhem is coming."

## POROUS FUTURES

South Florida is doomed; there is no saving it. The only productive discussions going forward will be discussions of exodus, of getting people out of harm's way and dismantling sensitive infrastructure (such as the Turkey Point nuclear plant) as cleanly as possible. Luckily, the U.S. has one major resource that most nations vulnerable to rising seas do not: abundant land to retreat to. So-called "managed retreat," the policy supported by geologists like Harold Wanless, represents the best option for South Florida residents.

Retreat, a barely reassuring euphemism for abandonment, would obviously be a hard pill to swallow, but it's better than the alternative: sudden mass evacuation once the water overwhelms the state or housing markets collapse.

Picture the humanitarian disaster of Hurricane Katrina multiplied a thousand times: the submerging of homes, missing loved ones, ways of life and livelihoods destroyed, life savings lost in rotting and unsellable homes, followed by a mass refugee exodus that makes the Dust Bowl look like a day hike.

If Floridians allow sudden abandonment to become reality, this is what lies in store. It will be up to them to decide if their migration will be coordinated and orderly, or hellish and chaotic — if they will plan for the future sensibly, or stick to their guns until the water rises to their doorsteps. Theoretically, much of the damage rising seas will cause can be averted simply by acknowledging and planning for the future. If Floridians can formulate an organized plan of retreat, they will spare themselves the potentially apocalyptic alternative.

Florida's government, in cooperation with the federal government, has the ability to adapt to the threat of rising seas. The most straightforward way to do so would be to offer South Florida's nearly seven million permanent residents financial incentive to move away from the coast. But a buyout on any kind of meaningful scale would require an immense amount of funding, as well as bipartisan support, both of which make the prospects of such a project unlikely to say the least.

If it can't incentivize its citizens to leave, then the least Florida can do is educate its citizens about the extent of the problem facing their state. However, based on the state's current political stance on climate change, it seems unlikely that it will do so. This dismal outlook merely points toward a deeper structural issue: Our economy and urban planning schemes are not designed to accommodate mass retreat scenarios. (Up until now, of course, they haven't had to be.)

Subsequently, it will probably be up to Floridians to plan for their own futures. If a mass buyout were to be floated, Americans beyond Florida would have to ask themselves if they would be willing to pay for such a program, or if they would rather let economics play itself out. Policies of managed retreat, massive federal programs to help the imperiled ... these must be the talking points in an age of rising seas, as the waters will only continue to increase for centuries to come.

If the higher-end estimates of geologists like Wanless become reality, and sea levels rise by 10 feet or more in the next century, we face a global human catastrophe unlike anything the world has ever seen. It won't just be Miami and Fort Lauderdale. It will be New York, it will be Boston, San Francisco, Baltimore, and Charleston; it'll be Osaka, Rio, Alexandria, Tokyo, Shanghai, Shenzhen, Bangkok, and

Jakarta — hundreds of cities across the globe, every one of them overtaken by the ever-rising sea.

Independent research group Climate Central estimates that at least 150 million people currently live on land that will either be exposed to chronic flooding or submerged by the year 2100, and that number will only increase. How will global society absorb what will become the greatest involuntary mass migration in human history? The point of this question is not to terrify everyone, but rather to generate constructive discussion about the future that awaits us.

We are heading into a world in which humanity will face challenges greater and more complex than any before, and we in the U.S. must ask ourselves difficult questions about what kind of country we want to be in that future. Will we be a country that plans ahead responsibly and supports its citizens, or a country that reels from disaster to disaster and forsakes those in need?

This is not a hypothetical. This is a call to action. The tide is rising. South Floridians must be the first to decide what to do about it. Hopefully, their actions will serve as a model. If not, well, you'll see it on the news.

By the time we arrive at Linda's apartment, it has started raining. It is one of those calm-inducing, powerful rains that happen only in Florida. We spend the afternoon sitting around the table, talking about things, talking about family, as raindrops batter the thick green leaves beyond the windows. I can hear someone on the television in the other room. Probably Rubio talking politics, I think, or the Weather Channel forecasting rain. Tourists are probably holed up in hotel rooms nearby, the families disagreeable, wishing for sun rather than clouds. I'm sitting in a chair on the second floor of a condominium that will not survive a 30-year mortgage when, unexpectedly, there's a knock on the door.

"The neighbors," Linda announces. "Please, let them in."

They're nice people, as she promised they would be, and we strike up a lively conversation. "Oh, this place is wonderful," they assure me — "and so close to the beach!"



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was researched and written for ESE 498, the CEW capstone course, in Spring 2018.

A satellite image of a Category 5 hurricane, showing a well-defined eye and a dense, swirling cloud structure over the ocean. The text 'Weather' is written in a large, bold, orange font with a metallic texture, and 'the STORM' is written in a large, bold, white font with a metallic texture. The background is a satellite view of the hurricane's eye and surrounding clouds over the ocean.

# Weather the STORM

**A Category 5 storm results in almost complete destruction of all mobile homes, commercial signage and fences, nearly all trees snapped or uprooted, a high percentage of frame homes extensively damaged, and most power poles downed, isolating residents for weeks or months.**



Climate Change

# ing

By Melissa Wagner



If you could walk a thousand miles, you'd make it from Key West, Fla., to St. Thomas in the U.S. Virgin Islands — provided you could walk on water. St. Thomas is only about 32 square miles, and

it takes about an hour to drive from one end of the island to the other. Like the British, you'd drive on the left side of the road. Like an American, though, your wheel would be on the left side of the car.

But if you were there on Sept. 6, 2017, you'd be getting pummeled by a Category 5 hurricane. A Category 5 storm results in almost complete destruction of all mobile homes, commercial signage and fences, nearly all trees snapped or uprooted, a high percentage of frame homes extensively damaged, and most power poles downed, isolating residents for weeks or months. For St. Thomians, this abstract enumeration of extreme weather threats became all too real.



A home lies in ruins courtesy of Hurricane Irma's devastation in the U.S. Virgin Islands. Credit: Shutterstock

FAR LEFT: The St. Thomas economy relies heavily on the island's picture-perfect bay to attract cruise ships and tourism. Credit: Wikipedia

Chicago native Kelly Jordan (right) enjoying a sunny day on St. Thomas before the storm. Credit: Kelly Jordan



time on the island as a photographer, showcasing the people and places of paradise. In the evening, he works as a bartender, pouring island staples like margaritas, bushwackers, and Coronas with lime.

Kelly Jordan, a 24-year-old Illinois native and loyal patron of Makil's work establishment, couldn't have cared less about the threat of a hurricane. She was running on island time (not that she didn't in her past life in the Chicago suburbs, but at least on St. Thomas it was socially acceptable).

In the days leading up to Irma, Kelly was bombarded by her family with questions about how many gallons of water she had purchased, whether she'd be moving to ground higher than her only slightly-above-sea-level apartment, and with offers to pay for a plane ticket home. She brushed off all questions and offers and instead reassured them that she had plenty of board games and enough booze to intoxicate a small village.

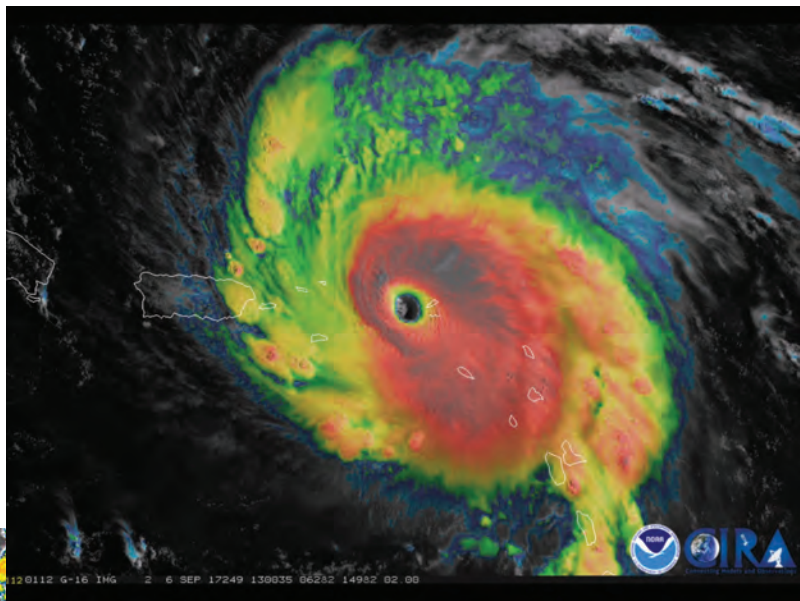
Kelly had moved from Illinois to the island in 2013, so having not experienced weather worse than a few feet of snow and below-zero temperatures, the idea of trouble in her St. Thomas paradise sounded as trivial as tourists squabbling over the high price of souvenirs.

Makil Bedminster, a native islander, was battered down with his family in Estate Bovoni on the south side of the island on that fateful day in September. They filled up the car and a few gas cans, purchased water, batteries, and generators, and reached out to their friends and family on the mainland. They had done this type of thing before. The last time St. Thomas saw a hurricane as destructive as Hurricane Irma was in 1995 with Hurricane Marilyn. Makil was only 2, his parents having moved to the island from nearby Dominica so that he and his siblings would be born U.S. citizens. They didn't expect to lose the roof of their home to Marilyn that year, but they didn't scare easily. They found a home among what Makil calls an "eclectic array of ethnicities.

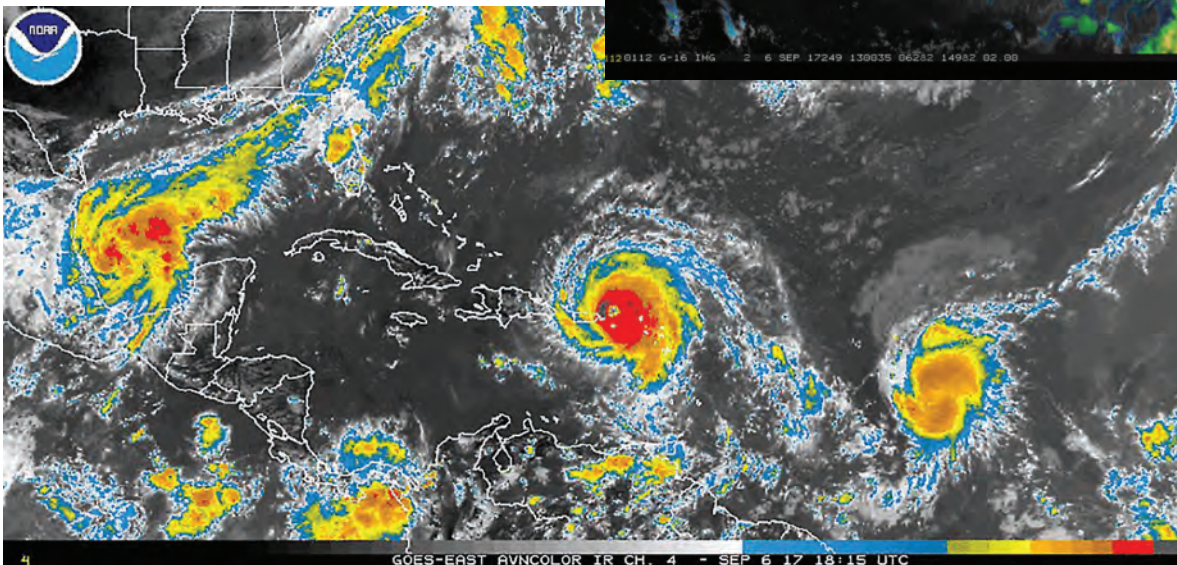
### And then came Irma.

"There's no sense of hierarchy when it comes to social class," Makil says. "There's not a big difference between the rich and the poor or the black and the white or anything like that."

A utopia, in other words, at least through mainland American eyes. An island full of lush flora and fauna, crystal clear waters with majestic sea turtles, and people as warm and welcoming as the sun. Makil works part-



Irma's advancing eyewall passed directly across St. Thomas and surrounding islands. Credit: NOAA





**It happened sickeningly slowly, and there was no escape. Millimeter by millimeter, Irma was moving so little that millions thought the monitor was frozen or the tracker wasn't refreshing properly. But this was no technical glitch ...**

Monitoring a monster storm like Irma is something that is, perhaps surprisingly, much easier to do off-island. The process has changed drastically since the calamitous Hurricane Andrew (1992) and even the more recent Hurricane Katrina (2005). Traditional media still exist, but crisis communication has taken on a notably different form. Instead of turning to a print newspaper to read about predictions the day a hurricane is scheduled to hit and reading about the aftermath the following morning, news outlets post live updates to their digital platforms.

Social media has also turned into a valuable source of news, with citizen journalists like Harold Defrieze, owner of the "What's Going On, St. Thomas?" Facebook page, posting videos and descriptions of the building storm in real time (content notably different from his usual announcements of bar specials and Full Moon parties). On the day Irma hit in the late, late summer of 2017, nest cameras also displayed live feeds of resort properties overlooking the ocean. But the best view, and the scariest, came from the satellites that send real-time images of developing storms to Earth, and share them with websites like Google that set up storm tracker pages, allowing viewers to follow a digital narrative of impending doom.

At about 1 p.m. Sept. 6, Irma approached St. Thomas. Kelly was texting her family through an app called Firechat that uses Bluetooth to send messages through any cellular device with the app, bouncing all the way from Illinois to the islands. The cybersecurity behind Firechat is questionable, as the messages are not encrypted, but most St. Thomas residents valued the possible post-storm, no-service means of communication with mainlanders higher than the risk of a hacked phone. At about 1:15 p.m., the

island went dark. Harold Defrieze's video postings came to a halt. The live feeds from resort cameras lost connection. Google's storm tracker showed the Category 5 storm inching over the Caribbean sea, dwarfing little St. Thomas and the even tinier surrounding islands.

The events about to unfold could only inadequately be described as a horror movie. You go to the theater for the entertainment, the popcorn, and with the hopes of jumping out of your seat a couple times. But then, in no time, you go home — you return to your bed safe and sound. When real-life Irma began to creep onto the shores of St. Thomas, it happened sickeningly slowly, and there was no escape. Millimeter by millimeter, Irma was moving so little that millions thought the monitor was frozen or the tracker wasn't refreshing properly. But this was no technical glitch ...

For almost eight hours, Makil, Kelly, and the rest of St. Thomas were whipped relentlessly by the brutal winds and fierce rains of a Category 5 hurricane. Talking heads on mainland TV talked about Irma all day, but only about the storm's potential visit to Florida, home of the admittedly vulnerable retirees of the nation. For the mainstream media audience in the Midwest, for example, it was like the entire Caribbean did not exist except as a doorstep to disaster. Like Kelly's friends had not spent their afternoon holding a heavy, sopping wet mattress up to the wall where the sliding glass doors had been yanked from their frame. Like the patients in the hospital on life support were not switched to the same portable generators used on camping grounds at music festivals. Like the islanders did not cower in their bathtubs after the roofs of their basement-less homes had been swept away like feathers



in the wind. Like people had not left shelter to survey the damage while the eye of the storm passed over the island, and found themselves stranded when the most destructive part of a hurricane, the wall of the eye, returned with a vengeance.

After seeing the satellite images and following Irma's destruction on the news, Kelly's Illinois family was aware that it might be difficult to contact her the day of or the day following. Phones might not be getting service, and power might be out. So Wednesday passed. Thursday, too. Then Friday, Saturday, and Sunday — and nary a text message or call. They were prepared to not hear back for a day or two, but an entire week without contact from someone who lives through her cell phone is nightmare material.

Makil's mainland family was less concerned. Having experienced hurricanes before cell phones and Facebook, immediate contact wasn't expected. Makil was able to get a call out after four days of living in primitive conditions — and that's not just speaking to the lack of technology. Over the four days, he and his family equipped themselves with saws and axes and worked on clearing the roads of the downed power lines and trees, combined with dangerously sharp debris that prevented them from getting the car any meaningful distance and to higher ground where a spotty signal was available.

"It was pretty messy," Makil said. "It was tough. It was busy. There wasn't much we could do but clean our roads so we could leave the neighborhood."

When Kelly's panicked parents finally got in touch with her a week later, they asked if she was fine. She wasn't. All of her friends were alive, but only a few had shelter, some had water, and only she had power. Luckily, the proximity of Kelly's apartment to the hospital meant that



A U.S. Marine hands off much-needed water supplies to a St. Thomas airport employee after the hurricane. Credit: Wikipedia

her street was prioritized in re-establishing electricity. Her family had minimal contact with her during the next two weeks but heard about arrests over curfew violations, hours-long lines for water, and muggings for generators. Eventually, she and her friends secured spots on a boat to Puerto Rico. Kelly said the boat carried about 30 people and about 20 dogs, and the only reason they made it on was because her friend won the "staph infection lottery" after bathing in a pool with a roof in it.

### Climate-related Disasters

The hurricane season of 2017 decimated entire swaths of land and displaced thousands. Suffering the brunt of Irma's force, the nearby island of Barbuda was essentially leveled. The question must be asked: Are these hurricanes part of a bigger climate picture? Upward trends on average annual temperatures as well as sea levels continuing to rise point to yes. In answering the question of how climate change will affect island lives and demographics, it helps to consider hurricane evacuation behavior, as it reveals a group's willingness to stay (or

**The question must be asked: Are these hurricanes part of a bigger climate picture? Upward trends on average annual temperatures as well as sea levels continuing to rise point to yes.**



In November 2017, useless stoplights still hung precariously as power and functioning signals slowly returned to the U.S. Virgin Islands. Credit: Shutterstock

**Commonly cited reasons for weathering a storm include wanting to protect property, wanting to protect property from looters, and fulfilling obligations to employers.**



Credit: Wikipedia

leave). After all, the island is its people. The islanders are the ones who created the unique culture of St. Thomas and preserved a tropical ecology synonymous with blissful escape.

A 2017 study on evacuations prior to Hurricane Sandy shows that individuals who rely on a variety of media for weather-related information are more likely to evacuate than those relying primarily on the internet. In September 2017, Hurricane Irma left hundreds of thousands without power, leaving islanders without access to television and internet. This makes the results of this study especially troubling, considering Hurricane Maria made landfall only two weeks after Irma. With no cell service, islanders retreated to traditional forms of media like newspapers and radio.

“Everyone kinda knew it was coming,” Makil said, “(but) I wouldn’t say everyone was prepared.”

A much earlier study, from the 1990s, offers different reasons for hunkering down. Commonly cited reasons for weathering a storm include wanting to protect property, wanting to protect property from looters, and fulfilling obligations to employers.

“During the storm, we were mopping up for 10 hours straight,” Makil said. “You know, as opposed to if we were off island, and then we couldn’t get back to our house to mop up that water for two weeks, where now there’s mold. Being there when it’s happening, when it comes to your house, it’s a bit more of a smart move to be present in a time like that.”

While expats and temporary residents may also have an interest in property, they have little risk to their livelihoods in terms of employment. Kelly could live without the sectional she called her “first big-girl purchase,” but a native islander with four kids working at a resort pummeled by Cat 5 winds can’t live without a job.

After the hurricanes, Makil’s mother and brother were left without work and had to leave the island. “He sells time-

shares,” Makil said. “Most of the main hotels on the island are still closed. Most of the main establishments that do timeshares aren’t open. There’s no need for employees, so at the moment he’s just at a standstill.” His mom has returned already, but his brother’s future is uncertain: “It’s not like he doesn’t want to return, but it’s all based on the job opportunities.”

While many of the Caribbean islands have rebounded, now welcoming as many cruise ships and tourists as they did the summer before Irma, the recovery is still incomplete. Vital infrastructure — buildings, roads, electricity, and water — will take years to fully repair, while some evacuees — St. Thomas’ human assets — still trickle back from the mainland states.

While Makil prizes the island for being so diverse and integrated, underlying circumstances reflective of centuries of oppression of minority populations remain. A study based on U.S. Census data determined the most “socially sensitive” areas in St. Thomas. In these areas, the population has more disabled persons, more families with five or more children, more kids under 5 and adults over 65, and more people living in group homes or institutionalized facilities than the rest of the island. In other words, far higher vulnerability.

The populations in these areas also have fewer vehicles, less telephone service and less internet access. These socially sensitive areas tend to be in the center of the island, away from the picturesque shores with the multimillion-dollar properties. Low-income public housing is concentrated there.

While everyone can gather around the campfire on the beach at night and chat like old friends, they’ve come from different places. The situations they go home to and the opportunities available to them if they leave are not the same. In the event of a hurricane, evacuating requires island natives to pay for flights or ferries and suffer the costs of leaving jobs. Natives also must have friends or families on the mainland to stay with; if they don’t, potentially costly temporary arrangements must be found.

FEMA provisions are an option, but they are limited. Add in the fact that islanders can't know how long they'll be gone, and weathering the storm becomes a necessity.

## Happy Returns?

But if the storm is not weathered, who comes back? Because Hurricane Katrina occurred more than a decade and a half ago, U.S. Census data serves as a good source of general information regarding pre- and post-hurricane demographics over time. And no, there is no better data than that from the U.S. Census or FEMA. There were no real systems in place to track evacuees and divert resources where necessary in 2005 except simple population counts before and after.

A study published in 2014 found that 53 percent of pre-Katrina New Orleans residents returned to the metro area, while only a third returned to the same home. According to the study, "most of the displaced adults likely faced considerable economic and institutional barriers in being able to move back to the city, such as the lack of affordable rental housing." What's really telling is the finding that blacks were considerably more likely than non-blacks to be living elsewhere than New Orleans a year after Katrina. It isn't a secret that people of color make up the greater part of populations requiring government assistance in Louisiana, a consequence of centuries of economic marginalization. With public housing complexes demolished and development at a near standstill, people who lost their homes might have found it cheaper to start over somewhere new. Meanwhile, investors and people with millions in their savings accounts were able to scoop up land for basement prices to build their McMansions and country clubs.

Now, it's clear that New Orleans and the Caribbean Islands are very different places, but they may have enough in common to provide useful predictions. Sure, Hurricane Irma and Hurricane Maria destroyed lots of hotel properties, but many of those establishments already have been bailed out by insurance. The hotels might be rebuilding — but what about their employees, and their homes? They haven't had the chance.

For example, Irma destroyed St. Thomas' Tutu Housing community that is now home to only 160 of the 285 families who lived there pre-Irma. More than seven months after the hurricanes, in spring 2018, Makil said that his community was in the same state as after the storm, which means less than half of the former Tutu families were still displaced. Those families were relocated to the mainland, but after FEMA cut them off they were on their own.

Meanwhile, the abandoned neighborhoods on St. Thomas that haven't been rebuilt are ripe for "redevelopment." So, culturally rich indigenous are at risk of being white-washed into just another Caribbean resort strip populated by Jimmy Buffett-style airport Margaritaville bars.

When you ask expats and temporary residents like Kelly why they moved to St. Thomas, you get a variety of

answers. What's more interesting than the reasons they come is the reasons they stay — and even more interesting, the things they value after living there for a few years. When the census was taken in 2010, 2.4 percent of the U.S. Virgin Islands population had moved there from the mainland U.S. within the past year, making the total of mainland U.S.-born residents about 16 percent of the island's population of just over 50,000. These new islanders might have been drawn to the island by the tourism commercials featuring tropical drinks and infinity pools, but that's not what they stay for.

A good way to understand the difference between tourists and temporary residents or expats is to consider "cruise ship days." The island can look very different depending on when you go. About once or twice a month, Royal Caribbean's luxury ship Harmony of the Seas meanders into port at Crown Bay. The Harmony is the second-largest cruise ship in the world and brings more than 6,700 people to the island, and there's almost always another ship of about 3,000-4,000 docking on the same day. On the busiest cruise ship day of the month, there is an 18 percent increase in the population, made up of Hawaiian print shirt-wearing, margarita-chugging tourists. U.S. transplants like Kelly avoid the cruise ship visitors like the plague. While she, like many of the expats and temporary residents, were once indistinguishable from the tourists, their time on the island absorbing its culture and natural beauty has led them to an appreciation of the island's natural elements — and there is nothing natural about neon green margarita mix.

While native islanders who don't work in the tourism industry also tend to avoid the ports on Harmony days, they would never wish them away. After Irma and Maria, Royal Caribbean, Norwegian and Celebrity all canceled visits to St. Thomas through the end of October. Tens of thousands of potential visitors were rerouted to the Western Caribbean, an area largely unbothered by the 2017 hurricane season. More than 100 shops in Charlotte Amalie, the largest city on St. Thomas, cater to tourists. With no cruise ships for over two months, the islanders subsisting on tourism income were faced with wrecked homes and stores and no money to rebuild them.

Shop owners weren't the only ones suffering from lack of tourism. Resort staff fared no better. Many of the main hotels on the island still weren't welcoming guests more than seven months after the hurricanes. The Frenchman's Reef, which is likely to need a year's worth of repairs before reopening, employed more than 400 full-time and part-time workers alone. "A lot of people leave or have left for a lot of different reasons, but the job opportunity is probably one of the main ones," Makil says.

Yet natives weren't the only people to suffer losses. Many businesses in St. Thomas are owned by expats and former mainland-U.S. residents. Enkai, a sushi restaurant in Crown Bay owned by former mainlander Steven Petsche, collapsed under hurricane-force winds. Even after a mostly unsuccessful attempt to crowdfund a rebuild, Petsche stuck around. He posted on Facebook every few

**With no cruise ships for over two months, the islanders subsisting on tourism income were faced with wrecked homes and stores and no money to rebuild them.**



Two months after the hurricane, a worker passes a damaged warehouse in the shadow of newly returning cruise ships like NCL's Norwegian Dawn. Credit: Shutterstock

days offering free labor and dry goods to anyone in need. Once, he posted about working three part-time jobs. A couple times, he talked about finding a new location. Often, he talks about his insomnia. Petsche obviously has fewer ties to the land than the natives, but all of the effort he put into putting down roots has been washed away by the storm.

### Natural Recovery

Rebuilding human infrastructure is one thing, but the environment is entirely another. The lack of a restaurant is obviously bad for business, but you can't just ask Mother Nature to pick up the physical pieces of that restaurant strewn across the pier and shore and restore the biological balance. This happened to Petsche and also to Mikael Doumeng, who posted on Facebook in March his relief that the freshwater runoff and flooding over his resort property (that had suffered tens of thousands of dollars worth of damage itself) had finally stopped. He included photos of the seriously eroded public beach at Bolongo Bay and added that the U.S. Army Corps of Engineers had visited and confirmed what they already knew.

No articles were written about Bolongo Bay; after all, it's a public beach. If it's not making money, it isn't getting any. According to Makil, only the big businesses on the island have received insurance money. On the topic of FEMA, he says: "When it comes to the residential and personal aspect, I myself and a lot of people that I know didn't find it very useful."

While the islanders may not have been able to rely entirely on FEMA, they do rely on each other. Born out of the Irma tragedy was the slogan "V.I. Strong," emblazoned on flags, Facebook profile pictures, and beautiful street art on St. Thomas. The islanders have exhibited their extraordinary resilience. And with that, there's hope. There's the launch of former U.S. President Bill Clinton's recovery efforts to improve children's health in the U.S. Virgin Is-

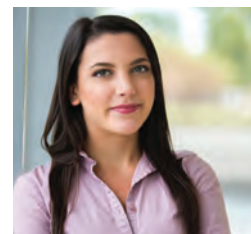
lands and FEMA's announcement of plans to improve the rebuilt power grid to withstand 200-mph winds.

That said, "anyone who has structural damage is rebuilding a lot stronger," Makil says. Given the perennial threat of destructive hurricanes, and their increasing power due to climate change, infrastructure as strong as its inhabitants is beyond necessary.

Kelly has already announced she won't be headed back anytime soon. She's keeping Trip, her St. Thomian dog whom she loves even with heartworms. She's also keeping Ben, her St. Thomian boyfriend whom she loves probably less than Trip. But she said she's not ready to experience anything like Irma ever again. She knows she's lucky to have the option not to.

Meanwhile, Makil is still on St. Thomas — and plans to be for the foreseeable future. He hopes his siblings will return and that things will one day return to normal, even in this new Caribbean with its yearly hurricanes on steroids.

"You never know," he says. "You just have to hope for the best."



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Living World

You are on a hike through an expanse of old-growth forest in the Pacific Northwest. As you admire the ancient green canopy overhead, your heart beats in tune with the life that exists here. Suddenly, you stumble upon a rotting log covered in a foreign-looking growth: orange-tinged, wrinkled, and porous. A feeling of disgust replaces the sense of connection you felt just a moment before. The irony? You are actually more closely related to this fungus than you are to the trees and other plants. The life form that you flinch away from is the very type from which you descended.

# IF Mushrooms could talk

By Emily Luce

We are fungal bodies estranged from our roots, and a necessary reunion is slowly but surely underway.

1.3 billion years ago, the North American soil we currently occupy belonged to the massive Rodinian supercontinent. The land was barren and rocky, as land plants had not yet evolved. A singular, massive ocean that surrounded Rodinia teemed with the earliest forms of microbial life: cyanobacteria, green algae, and fungi. A symbiotic relationship between these life forms, discovered only in the past few decades, was ultimately responsible for our current atmospheric conditions and all life that has evolved — including ourselves.

Fast-forward, if you will, to 540 million years ago and the Cambrian Explosion — the eruption of terrestrial life. It was roughly during this time that we split from fungi. Fungi became multicellular and went underground, while creaturely life hit the beach from the oceans. As subterranean life evolved, a tremendous species diversification occurred, resulting in 5 million known species of fungi today.

While outer appearances obviously differ, animals and fungi share more than half their DNA. Mushrooms, like us, inhale oxygen and exhale carbon dioxide. The two kingdoms belong to the same trophic level. Unlike plants, neither fungi nor animals are producers; instead, each uses an external source for food energy. Some of today's most successful antibiotics (such as penicillin, which was derived from the *Penicillium* fungus) were made possible due to our shared pathogens, as fungi don't rot from bacteria. More wonderful still, the basic reproductive structure of a fungus, the mycelium, involves a paradigm that can be observed throughout the universe. Its network-like design mirrors that of dark matter, neural connections in the brain, and even the human-created internet. As deep as fungi spiral into our planet's past, so too do they offer exciting pathways to a more earthy, sustainable future.

Fungi reproduce by means of spores. When germinated, the spores produce a mass of threadlike, single-cell-wide structures called hyphae — collectively known as mycelium. Often referred to as the web of life, mycelial networks transport and deliver nutrients to other plants in need. Though usually invisible to the human eye, mycelium is virtually omnipresent. It permeates nearly all land masses on Earth: a single cubic inch of soil can contain more than 8 miles of mycelial cells. And it knows you are there. With each step

you take on your hike through the forest (or backyard), the sentient underground mycelial mats spring to attention. Your small footstep initiates a breakdown of wood and other organic material; the power source for the mycelium. The sensitive membranes respond immediately in an attempt to collect nutritional debris.

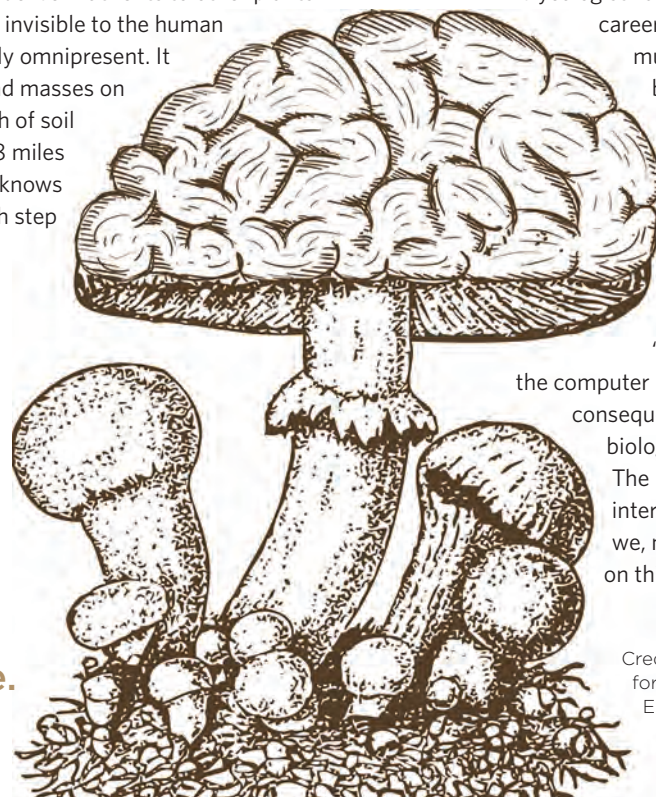
This system is so intelligent that a single North American fungus has achieved the title of largest living organism in the world. In Eastern Oregon lies a 2,200-acre honey mushroom mycelial mat that is almost 2,500 years old. More neural connections exist in a 1,000-acre mycelial mass than we have in our brains. The network-like design of mycelium allows it to respond to catastrophe; the cell density and sensitivity allows it to regulate new substances that it comes into contact with. Mycelium is in constant communication with its surrounding ecosystem and thus is able to prevent predators from consuming it. Clearly, the implications of common fungi don't warrant the "mycophobia" characteristic of current social attitudes.

**This system is so intelligent that a single North American fungus has achieved the title of largest living organism in the world. In Eastern Oregon lies a 2,200-acre honey mushroom mycelial mat that is almost 2,500 years old.**

Mycologist Paul Stamets has devoted his career to promoting a sustainable, mutually beneficial future between humans and their fungal ancestors. And as the Earth's environmental miseries mount, people are beginning to listen.

Stamets calls mycelium the "Earth's Natural Internet."

"I believe the invention of the computer internet is an inevitable consequence of a previously proven biologically successful model. The Earth invented the computer internet for its own benefit, and we, now, being the top organism on this planet, (are) trying to



Credit: Micah Kenfield, Institute for Sustainability, Energy, and Environment

**As deep as fungi spiral into our planet's past, so too do they offer exciting pathways to a more earthy, sustainable future.**

**What started as a pile of oily waste became an oasis of life after its treatment with mycelium. Hydrocarbon levels went from 10,000 parts per million (ppm) to less than 200 ppm.**

allocate resources in order to protect the biosphere,” Stamets declared in a much-watched TED Talk titled “Six Ways Mushrooms Can Save The World.” For Stamets, we need to engage our fungal allies in order to prevent a loss of biodiversity.

Increasing numbers of independent studies are being carried out by Stamets and others who are able to see an integrated future between humans and fungi. The results have been astounding,

in regard to both environmental bioremediation and pharmacological research.

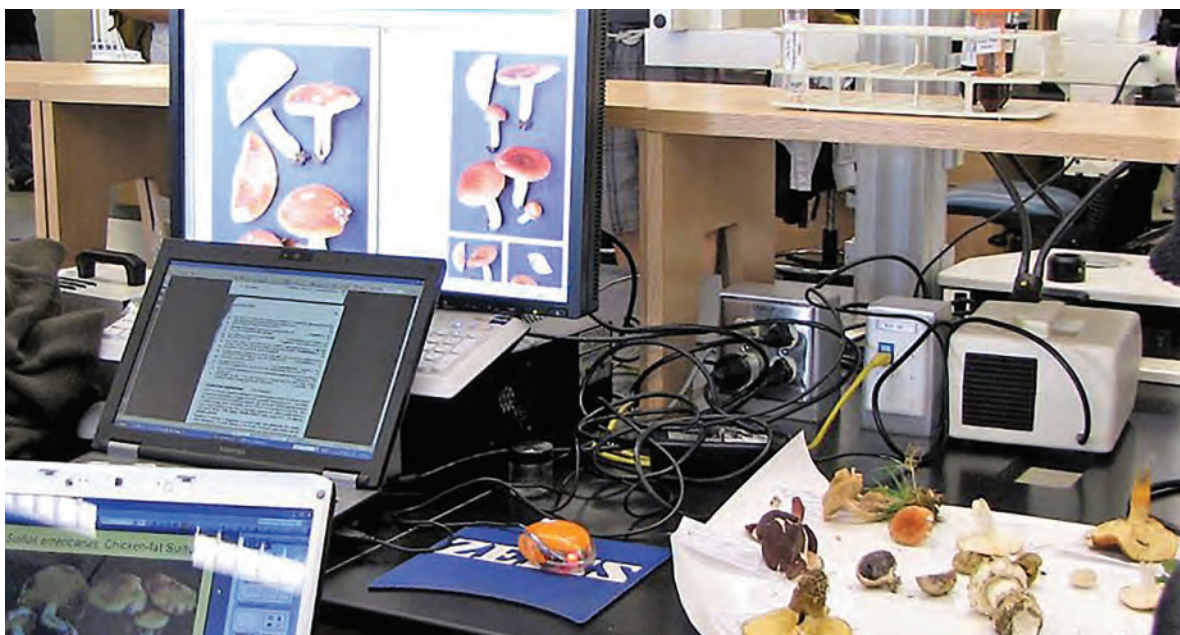
One such experiment conducted by Stamets, in cooperation with Battelle Memorial Institute Laboratories, demonstrates the remedial powers of mycelium. Four piles of organic material were saturated with diesel and petroleum wastes. One acted as the control pile and went untreated; one was treated with enzymes; another was treated with bacteria; and the final was inoculated with mycelium. After six weeks, the pile of waste treated with mycelium was the only one containing living oyster mushrooms. According to Stamets, the other piles were “dark and stinky.” The spores of the newly grown mushrooms attracted insects, which then laid eggs and attracted larvae as well as birds.

What started as a pile of oily waste became an oasis of life after its treatment with mycelium. Hydrocarbon levels went from 10,000 parts per million (ppm) to less than 200 ppm. By contrast, the other three piles remained toxic and lifeless. These results open up fungi’s extraordinary potential to naturally revitalize our increasingly polluted world.

The bioremedial properties of mycelium extend to another crucial issue of our time: saving the bees. We are heavily reliant upon these tiny buzzing insects and their tireless work as pollinators for the food on our plates. In recent years, colonies of honey bees in North America have been declining due to various stressors, including the glyphosates and neonicotinoids used as agricultural pesticides. A major bee affliction is deformed wing virus. Enter Stamets and mycelium. It turns out extracts from the amadou mushroom can double the lifespan of bees, and reduce the deformed wing virus by over a thousand-fold in just 10 days. Stamets has multiple patents pending after this groundbreaking discovery.

Consider how Winnie the Pooh reaches into rotting trees and produces a handful of honey. Bees are attracted to the mycelium that thrives in rotting wood. So as deforestation increases, mycelial habitats decrease, as does the bee population, and in turn the chances of Pooh finding his favorite snack.

Our fungal ancestors not only hold the power to heal our environment, but ourselves as well. Ongoing and



Mushroom ID Station at the Bioblitz Base Camp Lab. Credit: Wikipedia



Credit: Wikipedia



extensive research is shedding light on the remarkable medicinal properties of mushrooms. There are obvious limitations on the communication and acceptance of such research due to the illegality of psilocybin, a hallucinogenic compound that is present in certain mushroom species. Though taboo, controlled administration of psilocybin can have extraordinary healing benefits for conditions such as post-traumatic stress disorder (PTSD), depression, and certain cancers.

A massive amount of neural connections occurs while the brain is under the influence of psilocybin. The compound substitutes for serotonin and is able to activate neurogenesis, allowing new pathways to form in the brain. Stamets, who was cursed with a severe stutter as a child and teen, said he successfully rewired his own brain during a mushroom trip and was able to permanently rid himself of the embarrassing condition. Psilocybin and similar entheogens give users an enhanced sense of empathy, greater courage, and an extension of fear response; this is why the resetting of neurological pathways conditioned to fear (like PTSD) is possible. Similar expansion of cognitive function can be obtained through consumption of a legal strain of mushroom called lion's mane, widely sold as tea.

In the spirit of Paul Stamets, ethnobotanist Terrence McKenna has proposed an idea that might seem far-fetched yet makes you wonder. The reason why early humans evolved past other animal species in terms of

capacity for language, symbolism, and rituals is due to fungal interactions with hallucinogens such as psilocybin. The foraged fungal hallucinogens may have empowered neural pathways responsible for the elaboration of language, and thus propelled our species forward to the powerful position we now hold. Here, we must look back to our species' past in order to preserve our future. It's no wonder America's most celebrated writer on food, nature, and sustainability, Michael Pollan, has turned to hallucinogenic fungi as the subject of his latest best-seller.

The incorporation of mycelium into our fungus-phobic world certainly has barriers to overcome. Society has been conditioned to fear the unknown, and the mysterious fungal world from which we were birthed presents more than a few queasy questions. But we must resist being "biologically provincial" as Stamets puts it. The more we study this complex topic, the more we realize we don't know. At the very least, we should cultivate appreciation for our fungal ancestors, realizing that they have much to teach us. On your next hike, get down with whatever strange mushroom species you may see. Nose the dirt and eye the fungus. Realize that 500 million years ago, this was you. And 500 million years from now, it just may be the only vestige of our life that was.



**A major bee affliction is deformed wing virus. Enter Stamets and mycelium. It turns out extracts from the amadou mushroom can double the lifespan of bees, and reduce the deformed wing virus by over a thousandfold in just 10 days.**



Emily Luce is from the northern suburbs of Chicago. She earned her B.S. in Advertising from the University of Illinois in 2018,

and plans to live and work in New Zealand. This article was written for ESE 360, the introductory CEW course, in Spring 2018.



# FRANKEN



Waste Not

**D**espite having eaten what felt like a three-course dinner, the remaining food on my plate could have sustained another full-grown adult entirely on its own. Portion sizes in Eureka Springs, Ark., are no joke. I glanced at my uncle's plate across the table; it looked about the same. So, when our waitress came by to ask if we needed takeout boxes, I reflexively answered in the affirmative, feeling a rush of pride at my conscientious avoidance of food waste. Our waitress soon returned with two blindingly white Styrofoam containers in hand, and I began the difficult task of coaxing my food into its new residence. On locking the tabs together, the material emit-

ted an unbearable squeaking sound, worse than nails on a chalkboard. But when our waitress offered my uncle a box of his own, he stopped her in her tracks with a brisk, "No thank you, I don't need one," and produced a brown paper bag from what seemed like thin air. "For the compost pile," he added, in response to our waitress' baffled expression.

My uncle lives as far off the grid as possible. He doesn't have an email address, or use the air conditioning unless the temperature is pushing 100 degrees, or buy produce unless it's locally grown. What he does have are two compost piles, 18 hummingbird feeders,

and a dog named Cat (last name Stevens). So, I reasoned, this was definitely not an out-of-character move. But, as I stood there clutching my container and looking forward to the leftovers I would probably never eat, I couldn't help but wonder what exactly was so terrible about the innocent white package my uncle wouldn't stand for in his home.

Even as that thought flitted across my mind, millions of barrels' worth of petroleum were being stripped from subterranean veins in Venezuela, Mexico, Canada, Nigeria, Saudi Arabia, and the U.S. itself. In an average day, the United States produces roughly 14 million



Credit: Flickr



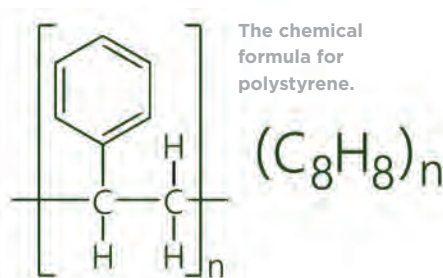
From petroleum comes the chemicals ethylene and benzene, which combine to form styrene, a building block of the plastic polymer polystyrene. Based on this long family genealogy of chemicals, compounds, and heavy production, it should come as no surprise that the U.S. Department of Health and Human Services deemed styrene carcinogenic in 2011.

# -FOAM

By Jenna Kurtzweil

barrels of petroleum while importing well over 10 million. From this massive haul of petroleum come the chemicals ethylene and benzene, which combine to form styrene, a building block of the plastic polymer polystyrene. Based on this long family genealogy of chemicals, compounds, and heavy production, it should come as no surprise that the U.S. Department of Health and Human Services deemed styrene carcinogenic in 2011, and that it has been banned from college campuses, communities, and even entire cities like Portland and San Francisco. Despite these concerns, polystyrene — the plastic patriarch of this long and toxic equation — is used by millions of people each day. Not only that, but it routinely comes into contact with our food and beverages. Why do we let this happen, knowing what we know about styrene? It's easy: Once it's wrapped up nicely and given a new, trendy name, expanded polystyrene is no longer viewed as a rogue chemical, but an integral part of our daily routine of food convenience.

Despite our daily interaction with polystyrene, our understanding of its history is vague at best, most notably its relationship to Styrofoam. While Styrofoam is indeed "a brand of expanded plastic made from polystyrene," brand is the definition's operative term. That's right: Polystyrene products are almost 100 years senior to the relatively recent Styrofoam, a single brand name nestled beneath the polystyrene umbrella (think Q-tips®, BAND-AID®, Jacuzzi®, the list goes on). Ironically, the product we think of as unquestionably synthetic was derived from nature's



poster child: the tree. In 1839, German scientist Eduard Simon made the accidental discovery of a Turkish sweetgum tree's resin — called storax — to derive a plastic-like substance he christened "styrol oxide."

The Berlin-born apothecary was able to do little other than isolate the material at the time; it took the research of early 20th-century scientist Hermann Staudinger to give context to the discovery. Staudinger, whose "pioneering work ... greatly contributed to the development of modern plastics," prompted the realization that "Simon's discovery, composed of long chains of styrene molecules, was a plastic polymer." Corporations were quick to harness the power of the polymer and distribute what was fast garnering a reputation as a miracle product. Germany's I.G. Farben piloted polystyrene's mass production in 1930, and in the U.S. the Dow Chemical Co. followed suit.

The sun had not yet set on polystyrene's evolution in 1941 when Dow scientist Ray McIntire advanced the durable but brittle polymer one step more with the invention of extruded polystyrene foam (XPS). In the tradition of McIntire's sweetgum-studying predecessor, his discovery was "purely acci-

dental," and "came about as he was trying to find a flexible electrical insulator" to help the war effort. Though serendipitous, McIntire's breakthrough was astronomical in terms of usability — XPS was buoyant, waterproof, and resilient to the point that "it was ... adopted in 1942 by the Coast Guard for use in a six-man life raft."

When Dow officially trademarked Styrofoam in 1946, it referred to something very specific: closed-cell XPS used for home insulation and known colloquially as "Blue Board" because of its characteristic hue. An archived DOW webpage explains that "today, the Dow STYROFOAM brand includes a variety of building materials ... pipe insulation and floral and craft products." However, the same page is quick to rebuke the misconception that every foamed polystyrene product on the market is associated with their brand, and emphasizes that "there isn't a coffee cup, cooler or packaging material in the world made from STYROFOAM."

The tendency to use a brand name in place of a specialized product is quite common (have you ever asked for a "Sharpie" instead of a "permanent marker"?), to the point that the malpractice has a name: "genericide." The term's ominous-sounding nature isn't that far off — by remaining ignorant of the difference between STYROFOAM and foamed polystyrene, we run the risk of misdirecting our environmental energies and negating efforts to make the world more sustainable. STYROFOAM home insulation products are not the enemy here.



College campuses cannot recycle the styrofoam used for to-go containers.  
Credit: Flickr

For example, through their sponsorship of Habitat for Humanity, Dow's "rigid blue board helps builders meet energy codes while lowering gas and electric bills." According to an article from *Plastics News*, "over the 50-year assumed lifetime of a building, the energy Styrofoam saves is more than 30 times the energy it takes to make it." In fact, Dow has made a concerted effort to keep its brand from being sullied by well-intentioned polystyrene challengers. According to an article from *The Washington Post*, Dow employs "a public affairs staff to keep tabs on the high-profile misuses of the term, and consultants who monitor major media outlets."

The issue, then, lies not necessarily with Dow's STYROFOAM, but with the infamously ubiquitous expanded polystyrene foam (EPS) convenience products. While its minuscule foam beads differentiate EPS from its insulating counterpart, the two materials have the same polystyrene foundation. And while indestructibility is useful when constructing bullet-resistant life rafts or efficiently insulated homes, the same cannot be said of coffee cups. It might seem attractive to drink from a cup that was borne of the need to be bulletproof, but ultimately, all we really require is a receptacle to get our beverages from here to there. Because once we've polished off our leftover hamburgers, drained the last dregs of coffee, or shaken the last few packing peanuts from our online purchases, we cast the once-revered polymer

unceremoniously to the wayside. Polystyrene: the product that requires countless chemical modifications to achieve the perfect level of chemically-clean-but-not-dangerous; the product whose base materials people in developing countries risk their lives to obtain each day, but which is doomed to rot in landfills without a second thought.

But sadly, the truth is that EPS won't rot. It was specifically engineered not to. The qual-

ities that make it such a valuable commodity — waterproof, resistant to mold and acid, clinical levels of sanitation — are the same that render organic decomposition nearly impossible, leaving discarded polystyrene to pile up in landfills already filled to the brim, and steadily leach chemicals into the environment.

So, the question remains: What do we do? The least invasive option is to recycle —

Habitat for Humanity house construction project using foamed polystyrene building materials.  
Credit: U.S. Air Force



Through their sponsorship of Habitat for Humanity, Dow's "rigid blue board helps builders meet energy codes while lowering gas and electric bills.



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theoretically, this allows us to continue using EPS products guilt-free at our current rate. However, recycling polystyrene is far from painless and nowhere near sustainable. On most plastic products, you'll find a small number surrounded by the three signature



arrows that denote best practices for recycling; if the item is polystyrene-based, it will sport a tiny number "6." According to the Natural Society, Plastic

No. 6 is often recycled into "egg cartons, vents, foam packing, and insulation"; however, polystyrene is as resistant to recycling as it is to decomposition, and can "(pose) a health risk, leaching potentially toxic chemicals, especially when heated. Most recycling programs won't accept it." Often, recycling plants can't accept it: According to HowStuffWorks.com, "new EPS is always needed for coffee cups and plates." Most times, it's just more economical not to recycle at all, and to churn out new batches of polystyrene to meet the growing demand. In the end, however, the best option might just be to opt out of polystyrene altogether. Maybe an addition to the traditional "three r's" is in order: Reduce, reuse, recycle, ... refuse?

Owing largely to ignorance (and probably laziness), the takeout box I briefly agonized over on that day in Eureka Springs was not

recycled or refused. As predicted, I did not finish my leftovers, opting instead to throw away the container in the garbage can immediately outside the restaurant from which it came. Months of production, years of research, culminating in less than 10 minutes of fruitless usage. From the dingy garbage can, full of grease-stained napkins and patterned with wads of chewed gum, the box will likely be transferred to a dump. It will remain in the spot where it lands for the next 500 years, undiminished, blindingly white like a spot of manufactured snow among the mounting piles of trash. If a Styrofoam box squeaks in a landfill and there's nobody there to hear it, does it still make you want to claw your ears off?

Even more stomach-turning is the realization that, whatever sound my takeout container makes, it will still be audible to your great-grandchild's great-great-grandchildren.



Jenna Kurtzweil is from Inverness, Ill. She received a B.A. in English and the Certificate in Environmental Writing in May 2019. She served

as a Communications Intern at the Institute for Sustainability, Energy, and Environment (iSEE). Kurtzweil hopes to pursue a writing career involving sustainability and the environment. This article was written for ESE 360, the introductory CEW course, in Spring 2018.



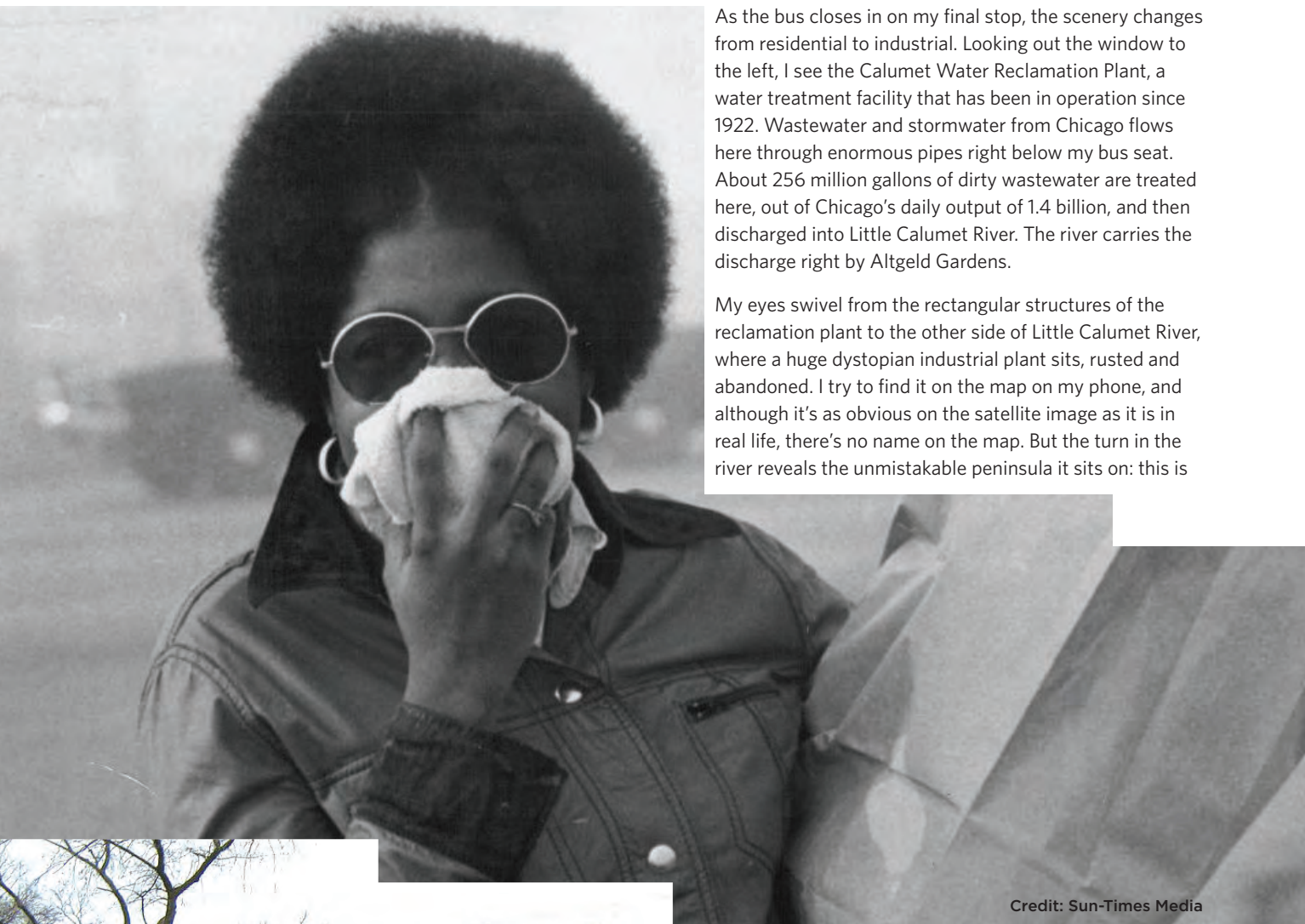
# The Mother of Environmental Justice

By Lisen Holmström

To get to Altgeld Gardens, I take the Chicago Transit Authority's Red Line to 95th Street and then Bus 34 toward 131st and Ellis. It takes about 90 minutes, but I don't mind. What surrounds the public housing community in Southeast Chicago interests me just as much as Altgeld Gardens itself. I'm heading there to see Cheryl Johnson, daughter of "The Mother of Environmental Justice," Hazel Johnson. She has agreed to meet with me in the office of the grassroots activist organization her mother founded in the late 1970s.

As the bus closes in on my final stop, the scenery changes from residential to industrial. Looking out the window to the left, I see the Calumet Water Reclamation Plant, a water treatment facility that has been in operation since 1922. Wastewater and stormwater from Chicago flows here through enormous pipes right below my bus seat. About 256 million gallons of dirty wastewater are treated here, out of Chicago's daily output of 1.4 billion, and then discharged into Little Calumet River. The river carries the discharge right by Altgeld Gardens.

My eyes swivel from the rectangular structures of the reclamation plant to the other side of Little Calumet River, where a huge dystopian industrial plant sits, rusted and abandoned. I try to find it on the map on my phone, and although it's as obvious on the satellite image as it is in real life, there's no name on the map. But the turn in the river reveals the unmistakable peninsula it sits on: this is



Credit: Sun-Times Media



the sprawling Acme Steel Mill that operated from 1918 until the company filed for bankruptcy in 2001.

I keep searching the map on my phone to see what other old factories are located in this area: industrial plants, a recycling center, landfills. But then there's also open green space, blue water, and a forest preserve. Suddenly we leave the factories behind and enter a housing complex, far too well-structured and uniform not to be built all at the same time. This is Altgeld Gardens, where I get off the bus.

Pretty much immediately, I get lost. I'm not the only one this happens to; I've heard residents describe this area as a labyrinth. Apparently, even police and firemen have trouble finding the right unit when they get a call. It's a weekday, right before noon, and the area is completely empty. All the houses look the same: two-story brick buildings with a grill and some chairs outside every entrance. After a while I can't tell if I've seen that playground before, or if this is another one. A helicopter flies by, and as it's the first sound I hear in a while, it makes the area feel even emptier. Almost tranquil. The old factories and landfills emit no sound. But I can smell them. I remember reading a quote by Hazel Johnson where she describes the Altgeld air as three distinct smells: a sulfur smell, a chemical smell, and an odor like corpses.

I arrive at what I think is the center of Altgeld Gardens, but what makes me unsure is that it's lacking the shop-fronts that in my mind constitute an urban center: stores, restaurants, banks, cafés, perhaps some kind of transit station. Or at least people moving around. A car finally arrives, and a young girl yells goodbye and waves to her dad as she quickly hops out of the car and skips through a short breezeway toward her school. As she disappears, I recognize the breezeway from my internet research: It's the yellow brick memorial wall.

While famous walls don't tend to symbolize positive things, not all symbolize death as bluntly as this one. In addition to a somewhat scratched-off layer of yellow paint, the wall is covered with big black letters. They make up names of Altgeld Gardens' dead, those who died long before their time. Some of the deaths were due to violence, but most belong to the housing complex's toxic environmental legacy unearthed by Hazel Johnson. And the names are spreading, like cancer. They no longer just cover the yellow-painted parts of the wall; they've worked their way all the way up to the ceiling. As I look at it, I wonder if it should be called "the Wall of Environmental Deaths."

**"You will not have this happening in an affluent white community. If you are poor, you get dumped on."**

**Cheryl Johnson**

When I arrive at People for Community Recovery (PCR), Cheryl Johnson isn't there, but some of the other members let me in. The office is now located in one of the two-story apartment buildings, and as there is no sign outside, I rely on locals to show me the place. The walls inside are filled with research posters with infographics about pollution, as well as awards and pictures of Hazel Johnson that keep me busy for a while.

When Cheryl gets there, I ask her why a public housing complex was ever built in such a heavily industrialized area. Cheryl and I sit down at a table filled with pile on pile of research on air pollution in the area. Cheryl is the current Executive Director of PCR, taking over after her mother passed away in 2011.

"The city of Chicago knew the land was contaminated when Altgeld Gardens was built," she says. "But there was a great need for housing, particularly for black veterans."

Altgeld Gardens was built in the 1940s to house black veterans coming back from World War II. It was one of America's first public housing projects and might still today be one of the best — at least according to a narrow definition of urban planning that ignores the environment.

Hazel Johnson was born in New Orleans in 1935 and quit high school after her sophomore year. She worked at a produce company when she met her husband John at 17, and they had seven children together.

The Johnsons moved to Chicago and Altgeld Gardens in 1962, when it opened to renters without veteran status. They had visited Altgeld Gardens before: Hazel's brother-in-law, who was a veteran, had been living there for some time. She'd fallen in love with the place. Although it was isolated from other residential areas by highways and industrial plants, it was also peaceful, green and serene, close to water and a lot of open space for the kids to run around in. The seven kids could even stumble upon wildlife such as deer and coyotes close by the new home. They signed the lease, and Hazel was thrilled.

But, as it turned out, this public housing paradise had dark secrets buried beneath it. Long before architects Hans Naess and Charles Murphy put pen to paper to draw up Altgeld Gardens in the early 1940s, the area had been a dumping ground for toxic sludge waste from the Pullman Palace Car Company for decades. With all the waste facilities and heavy industry, the ground where the architects turned the first sod was heavily polluted. John Johnson didn't end up living in Altgeld Gardens for very long. In 1969, lung cancer caught up with him, and he passed away at age 41. Cancer, as well as asthma and respiratory problems, seemed to be catching up with many of the neighbors in the area. It had become normal in Altgeld to have family members with a number of health problems.

But there were other issues to deal with in the community. Roofs were leaking, paint was peeling off, and water pressure was little to none in most houses. Hazel, now a widow with seven kids, founded the group People for Community Recovery in 1979. She wanted to organize the community to bring up quality-of-life issues and question the Chicago Housing Authority's (CHA) poor maintenance of the buildings. It was so unreasonably hard to get anything, even a broken window, fixed. However, it didn't take long for the health issues to come knocking again. And this time they would be impossible to ignore.

A local case including four mothers and four little baby girls was brought to Hazel's attention.

"The four mothers had all grown up in Altgeld and lived almost next door to each other," Cheryl tells me as she reaches for a cardboard box to show me that the babies were so tiny they could've fit in it. The babies had all been diagnosed with multiple forms of cancer. "And nobody was talking about it. You know, cancer during that period of time was shameful; people kept it hidden. Instead of understanding that when you have a cluster of same types of cancer in a defined area, it's signifying that something is going on."

None of the little girls would live to see their seventh birthday. This wasn't happening in every Chicago neighborhood — that was for sure. Sitting at home watching television one night in the late 1970s, Hazel started connecting the dots. The news anchor was talking about a new study by the Illinois Department of Public Health. It showed that the cancer rate in South Side Chicago was a lot higher than average. And on the South Side, Altgeld Gardens, together with Calumet City, were the two areas

that had significantly more cancer cases than the rest of the city.

Hazel picked up the phone and called everyone she could think of who might have answers. She called authorities in Chicago, and then started calling Washington, D.C. She contacted academics and activists. This was what she found out: She was living in an area surrounded by 50 documented old landfills as well as 382 polluting sources, including Sherwin-Williams Paint Co., PMC Specialty, Ford Motor Co., the Metropolitan Water Reclamation District of Chicago, Waste Management Inc., and many others, that were leaking toxins into the ground, water, and air in her community. Once Hazel learned this fatal fact, Altgeld Gardens was no longer paradise to her. Her neighborhood was blighted. She would come to call it "The Toxic Doughnut."

People for Community Recovery was a pioneering environmental justice organization. United with neighboring areas such as Hegewich, Pullman, and Calumet City, hundreds of people protested against a Waste Management hazardous landfill in 1989. The landfill had already been suspected to leak toxins, and now the company wanted to expand with a new treatment facility. After the media had all left the rally, Waste Management had the protesters arrested. But they got out of jail and went on to protest a local incinerator.

Hazardous chemicals were even closer than Hazel Johnson first thought. Not just the air, water, and land were contaminated, but the houses themselves were toxic.

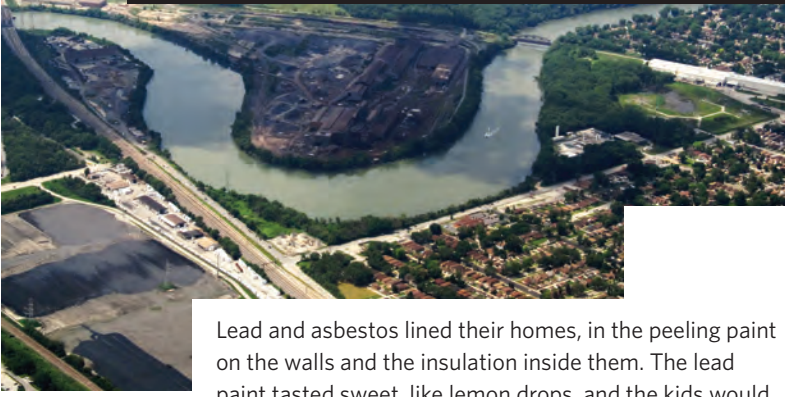


The memorial wall in Altgeld Gardens.  
Credit: Lisen Holmström

While famous walls don't tend to symbolize positive things, not all symbolize death as bluntly as this one. In addition to a somewhat scratched-off layer of yellow paint, the wall is covered with big black letters. They make up names of Altgeld Gardens' dead, those who died long before their time.



The abandoned Acme Steel Plant on the Little Calumet River, adjacent to Altgeld Gardens.  
Credit: Ken Lund



Lead and asbestos lined their homes, in the peeling paint on the walls and the insulation inside them. The lead paint tasted sweet, like lemon drops, and the kids would eat it. Asbestos had been commonly used in insulation and is believed to have caused thousands of deaths in the United States.

The activists in Altgeld Gardens had now teamed up with a young community organizer named Barack Obama, just graduated from Columbia University. They pressured the CHA — which first denied an asbestos problem — to finally pay to remove it from all the houses. Then another shoe dropped. Hazel learned that barrels of polychlorinated biphenyl (commonly known as PCB), used as lubricant in old electrical transformers, had been illegally dumped in a storage unit in Altgeld Gardens in the 1970s.

“It was an undercover deal; someone got kickbacks to allow them to dump it here. That same person was also living out here, so he didn’t know what he was doing. He eventually died from cancer, too,” Cheryl says. It took about 30 years and a class-action lawsuit against the CHA to get the area cleaned up. “And if you ask us, as an environmental group, it’s not really clean.”

People for Community Recovery started to collect data on health trends in the community, hoping to be able to prove that the health problems were caused by the pollution. Their health surveys showed that 90 percent of the residents had respiratory troubles, skin rashes, burning eyes, and other ailments commonly connected to air pollution. And then there were the continuing sky-high cancer rates. But environmental links to cancer are not straightforward to prove. Neither, in Altgeld Gardens, was proving accountability.

“It’s difficult in this area when you have over 300 polluting entities” Cheryl explains. “If you connect a

chemical to one industry, he’s going to say, ‘No, that isn’t mine, that came from somebody else; we both use the same chemical.’ ”

The buck stops nowhere. Even though a lot of research has shown that zip codes can be linked to increased mortality risks, there is a lack of consensus about what it is about a neighborhood that specifically effects resident health, and in what ways. Researchers have pointed to different factors, such as access to fresh food, proximity to health care, and social marginalization, in addition to environmental dangers.

Meanwhile, the dangers of the Toxic Doughnut also seem to be different depending on who you ask. When PCR and Greenpeace tested the drainpipes of a nearby landfill, they found excessively high levels of carcinogenic and toxic chemicals in the Calumet River. But when the Environmental Protection Agency conducted a soil test in 1996, after years of pressure from the Altgeld community, it concluded (based on “limited information”) that “no apparent health hazard exists from exposure to the surface soil contamination detected in Altgeld Gardens.”

Even without conclusive studies, PCR members have always been sure that the large amounts of chemicals measured in Altgeld Gardens and surrounding areas can be deadly. As Hazel once wrote: “We have to fight for our children. We have educated ourselves on environmental issues and the health threats from nearby polluting industry. We have not waited for government to come in and determine the cause of our illness. We may not have Ph.D. degrees, but we are the experts on our community.”

She was right. And as it turned out, Altgeld Gardens wasn’t the only minority community experiencing the burden of waste-dumping. Soon, the environmental justice movement, on the Altgeld Gardens model, had spread nationwide.

From the beginning, Altgeld Gardens was an overwhelmingly black community, with 62 percent of residents living below the poverty line. In Chicago, one of the most segregated cities in the U.S., the hard work by white segregationists had shaped the city to make dumping toxins on minority communities possible. Karl Grossman writes in his book *Environmental Racism* that without racist zoning laws in the 1920s, a housing complex like Altgeld Gardens would never have been built in such a heavily polluted area.

CHA director booted from talks on asbestos  
Devall, Cheryl  
Chicago Tribune (1963-Current file); Jun 10, 1986; ProQuest Historical Newspapers: Chicago Tribune  
pg. A2

## CHA director booted from talks on asbestos

By Cheryl Devall

Residents of the Altgeld-Murray housing project on the Far South Side greeted Chicago Housing Authority executive director Zirl Smith with boos when he met with them Monday night to discuss the discovery of asbestos in their apartments.

seizure. The CHA director left, saying he was going to call an ambulance on the two-way radio in his car.

The tenants, angry over his tardiness and confused about his sudden departure, followed him out the door, chanting “No more rent.” Residents and reporters tried to ask questions and Smith’s

South Side's high cancer rate cited  
Casey Bukro  
Chicago Tribune (1963-Current file); Apr 25, 1984; ProQuest Historical Newspapers: Chicago Tribune  
pg. 10

## South Side's high cancer rate cited

By Casey Bukro  
Environment writer

A HIGHER STATISTICAL incidence of cancer was discovered in the Calumet and Altgeld Gardens areas in comparison to the City of Chicago as a whole in results from an environmental health study of the South and Southeast Sides soon to be announced by the Illinois Environmental Protection Agency.

Bill Clinton signs the landmark 1994 executive order on environmental justice. Hazel Johnson is standing third from right. Credit: PCR



Hazel Johnson and the “Toxic Doughnut” map. Credit: PCR

## Hazel Johnson stood next to President Clinton’s desk in the Oval Office as he signed the Executive Order 12898: “Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations.”

“You will not have this happening in an affluent white community,” Cheryl insists. “If you are poor, you get dumped on. You get the burden of the pollutants in your neighborhood because of the fact that you are apolitical. You don’t have that voice to make policy change, or to make enforcement happen that is already on the book to protect public health. But race is one of the common denominators in this.”

Hazel Johnson worked tirelessly to raise the voices of the poor. During the ‘60s and ‘70s the environmental movement in the U.S. had been a mainly white and middle-class movement focused on preserving wildlife. She joined anyway, but was usually the only minority representative at the conferences and gatherings. Her perspective was different: She was concerned with human health issues in relation to the environmental ones. She wouldn’t be alone for long, as the environmental justice movement grew rapidly.

The movement doesn’t have one recognized starting point. Complaints from minority communities about unfair environmental burdens had already been going on for decades, but during the 1980s these separate complaints merged into a movement. Often mentioned as the first big event was a massive protest against a landfill for illegally dumped PCB-contaminated soil. The landfill was to be placed in a small black community in Warren County, N.C., and the National Association for the Advancement of Colored People (NAACP) decided to organize against the siting. Although the protest — during which 500 protesters were arrested — was unsuccessful in preventing the landfill, the similarities with the situation in Altgeld Gardens and other minority communities was obvious, and a nationwide network of environmental justice organizations started forming. In 1983, the General Accounting Office found in a study that African Americans made up the majority of the population in three of four communities in the Southeast where toxic waste facilities had been placed. It would take until the 1990s, however, for the federal government to recognize environmental justice as a political issue and human right. When Hazel Johnson

attended the first National People of Color Environmental Leadership Summit in 1992 in Washington, D.C., she was officially named “The Mother of Environmental Justice.”

“My mother had a way of reaching people’s hearts, telling the same story over and over and over again. Didn’t change it at all,” Cheryl says. “But a lot of people felt her, and they were really amazed that a widow with seven kids, living in public housing, was talking about environmental issues. And being a black woman. That was just unheard of.”

Two years later, Hazel Johnson stood next to President Clinton’s desk in the Oval Office as he signed the Executive Order 12898: “Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations.” The photograph of Clinton signing the document is one of the pictures hanging on the wall of the office in Altgeld Gardens. For Hazel, it was a moment of official recognition in a long career spent challenging officialdom.

Cheryl gets a phone call and excuses herself from the interview. As she does, another long-time activist named James Carlton admits he’s been listening in on our conversation.

“I was thinking,” he says, “PCR has never really taken the credit it should for being the oldest environmental justice organization in the United States — and opening other parts of the country’s eyes to environmental justice.”

Hazel Johnson passed away in 2011, but her legacy lives on. Her national and international impact endures in the way she enlightened the world on issues of environment, equity, and public health. Environmental justice issues have become mainstream in federal and local government, and central to the broader environmental movement. But for all this success, great challenges remain — most of all money.

“One of the biggest challenges was that the big environmental groups were getting all the attention. It’s still the whole perception of saving the whales and the trees, not



Cheryl Johnson is continuing the fight. Credit: PCR

talk about human health. Now, we're addressing the real issue of equity," Cheryl says. "Environmental groups like ours, for example, we are still grassroots, we're still underfunded. How do we become totally funded, like Sierra Club, like the National Environmental Defense Fund?"

In the small office in Altgeld Gardens, Washington feels far away. But the newly gutted budget for the EPA can still affect communities like this one.

"We see some of our accomplishments being rolled back under this current administration, things we've been fighting for for many years," Cheryl says. "Like with the Clean Air Act that President Obama put up. But I think it's really forced us to look at things happening on a local level now, rather than on a federal."

So, People for Community Recovery continues to monitor the neighborhood's air quality. Members work with the Housing Authority to make Altgeld Gardens into a solar community, putting all the open space available to use in the name of sustainable energy and a toxin-free future. Another hope Cheryl shares with me before I leave is to make Carver Primary School — named after George Washington Carver, the botanist and inventor who developed techniques to improve soil depletion — into an environmental school. Environmental training programs already exist so that people from the area can get green jobs, and the hope is to build both a research center in the neighborhood and an Environmental Justice Museum with exhibitions about grassroots efforts all over the world. At the same time, the city of Chicago is planning to develop in Altgeld Gardens.

"They are proposing to put new structures out here like a new library, a new day-care center, and the new railroad; the CTA Red Line extension is going to come all the way down here," Cheryl said. But of course, developments do not come without the threat of gentrification. Before the housing crash in 2008, plans to build waterfront property off the Little Calumet River were proposed. "I saw that plan and it was pretty," she says. "But it wasn't for our income level, it wasn't for poor people. It was going to be a gated community."

While PCR is often portrayed as only an environmental organization, the group also works with housing rights, helping clients receive fair and equal treatment in housing issues. "With all these opportunities coming to this area now, you just have to be on guard, the gatekeeper for your

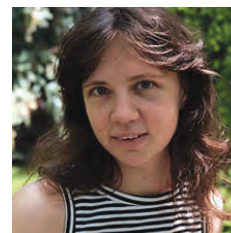
community. To make sure that it will still be here," Cheryl says.

As I leave Altgeld Gardens, I pass the sign that declares the 2016 name change of the old South 130th Street. It's now named "Hazel Johnson EJ Way."

I stay in Chicago for a few days to hear Nigerian-American writer and critic Teju Cole read at the Museum of Contemporary Art, where Nigerian artist Otobong Nkan-ga has an exhibit. In his reading, Cole reflects on the time when his family moved to a less affluent area in Lagos, Nigeria, neighboring a roadworks plant that was spitting out black smoke: "For the next few years, that smoke was part of our life. There was no question of moving: this was the family house, the home we had built. But there was no real avenue of complaint either. The roadworks plant was run by a famous multinational company. Where would we begin? And thus did that black smoke come to rule our lives. It sprayed a grey on the washing on the line. It got into the tea. It smelled like burning tar or burning tires. It stung the eyes. It was, at the time, an inconvenience or irritation, an extra thing to clean away. Only now, in retrospect, do I understand how injurious it was and how intolerable it should've been."

Environmental justice is an international phenomenon, linking the South Side of Chicago to other exploited communities across the globe. Cole's father in Nigeria eventually got very sick from the dust in his lungs, but survived. On the far side of the Atlantic, in Chicago, Cheryl's father was not so lucky. But Hazel Johnson did find it intolerable earlier than most people — and she did find avenues for her complaints, even though no path existed for her to follow.

In 1995, the tireless Mother of Environmental Justice told the Chicago Tribune: "Every day, I complain, protest, and object. But it takes such vigilance and activism to keep legislators on their toes and government accountable to the people on environmental issues. I've been thrown in jail twice for getting in the way of big business. But I don't regret anything I've ever done, and I don't think I'll ever stop as long as I'm breathing. If we want a safe environment for our children and grandchildren, we must clean up our act, no matter how hard a task it might be."



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University of Illinois. This article was researched and written for ESE 498, the CEW capstone course, in Spring 2018.



# Stains That Won't Wash Away

By Anita Clifton

I grew up a resident scullery maid — and elevated washing dishes by hand to an art. My mother and I were by all definitions poor, and our meals were always without canned or boxed convenience but made from scratch. This meant lots of dishes. Four decades later, being a mom of four and with a deep-rooted love for fresh-tasting food still has me at the kitchen sink, throwing contemptuous side glances at our dishwasher during post-dinner cleanups.

Reaching for the bottle of liquid dish soap that sits eternally on the counter, I begin the task of scrubbing a like-new quality back

to the charred and crusted baking dishes beside the sink. Then, I will generously squeeze more soap over three large sections of countertops and scrub some more, for the sanitary claims of the “antibacterial” labeling. This is a daily ritual, one I have estimated will consume a 28-ounce bottle of dish soap in approximately 16 days. Whatever ingredients liquid soap makers are using to sanitize our kitchens, four gallons of it are being disposed of annually in the Clifton household. If other “scullery maids” used just half of this, that still means for our community of about 5,000, that approximately 20,000 gallons of liquid soap (enough to fill Dodger Stadium), going down drains to somewhere else — to somewhere the dirt and contaminates belong — outside our home.

I set out to the store with a coupon for Dawn dish liquid. A rainbow of bottles containing tinted gels line the supermarket’s detergent aisle. Each label reveals a fragrance to a corresponding translucent gem-colored liquid. For a 28-fluid-ounce bottle of Dawn, I will pay

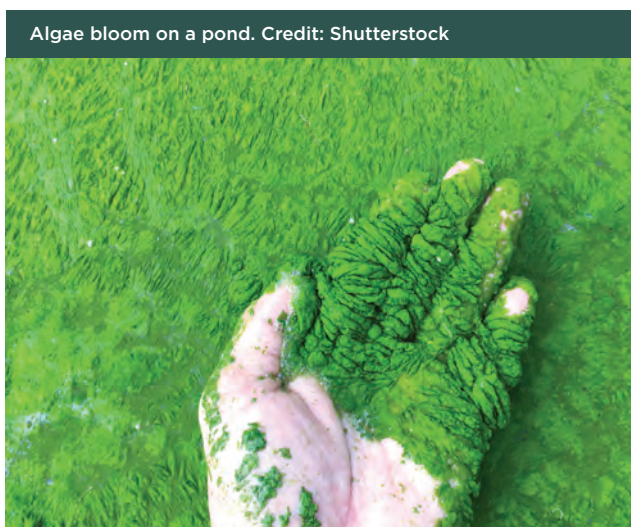
approximately \$3.25, \$1 of which will be donated to a wildlife fund. This marketing strategy must be working well for the makers of Dawn. According to Statista, a marketing-based company that gathers data on 80,000 consumer goods around the world, dish and laundry detergent made \$206.69 billion worldwide in 2016.

In my own micro-survey, I asked three other moms at my daughter's soccer game what dish soap they buy. Of Dawn, one mom simply states, "It's what my mom used, and so now it's what I use. Plus it's just better at cleaning." The second mom firmly believes in supporting Dawn's wildlife cleanup effort. Both have brand loyalty and only buy Dawn. The third mom, like myself, will switch around for the best deal.

In the early 1900s, Proctor & Gamble (P&G) realized the importance of creating a brand, having an appealing package and then advertising the product on a mass scale. But they accidentally struck marketing gold in 1989 with Dawn dish soap. The Exxon Valdez oil spill in Prince William Sound was the largest ever spill in U.S. waters. Alice Berkner, founder of the International Bird Rescue Research Center, secured a small grant from Chevron to test dish soaps on oil-covered fowl in the wake of the spill. Dawn cut the grease faster and better than any of the soaps that were tried.

The offshoot of this tragic disaster was the good citizen award for P&G — and the loyalty of consumers who wanted the chance to participate in helping with the cleanup effort. Since then, an even larger spill in the Gulf of Mexico, 2010's Deep Water Horizon incident, has elevated Dawn to wildlife rescue royalty. The soap-maker's pledge to give back \$1 for every bottle of Dawn sold, quickly allowed them to cut a \$500,000 check to wildlife causes.

My small survey of soccer moms is a microscopic confirmation of the success in consumer loyalty these advertising strategies have had. There's some irony in the loyalty



Dangerous levels of phosphates occur due to three major human contributions: wastewater treatment, industrial discharge, and excess fertilizers in agriculture. This ingredient promotes what is called an "algal bloom" in important freshwater sources. Blooms are created by disposal and runoff of phosphates from detergents and can become a covering of toxic scum resting on top of the water's surface.

to Dawn has secured by its use to clean animals after oil spills. "What the company doesn't advertise — and these days is reluctant to admit — is that the grease-cutting part of the potion is made from petroleum," Dawn spokesperson Susan Baba said in an interview with NPR.

What other toxic magic is in that bottle on which we spend so much to sanitize our lives? Curious, I went back in the archives of soap-making to try and better understand. Florence Nightingale's rise to fame was attributed to helping Britain with the use of soap and instituting hygienic practices in nursing. This concept aided the Americans in the Civil War, which later propelled the manufacturing of soap into an industry. What historically started as a basic mixture of an alkali substance and a fat or oil now is a Frankenstein's monster of chemicals.

Phosphates are the godfather of the sapone family. Phosphates are molecules composed of phosphorous and oxygen, both essential to healthy freshwater environments. Phosphorous can cause plankton and plants to grow, which is great for animals and fish to eat. An overabundance of phosphates, however, can deplete the level of oxygen in a water body through a process called eutrophication. A lack of oxygen causes aquatic life to suffocate and die. Dangerous levels of phosphates occur due to three major human contributions: wastewater treatment, industrial discharge, and excess fertilizers in agriculture. This ingredient promotes what is called an "algal bloom" in important freshwater sources. Blooms are created by disposal and runoff of phosphates from detergents and can become a covering of toxic scum resting on top of the water's surface. It appears as a blue-green paint spill.

Most information I received in the past decade regarding cleaning was germ-centered — typical for a stay-at-home mom. The latest bleach-infused wipes or concentrated antibacterial soap on the market were hot topics at post-church lunches, indoor play places, and doctors' waiting rooms. The bombardment of advertisements on televi-



The presence of phosphates promotes “algal bloom.” Credit: Shutterstock



ABOVE: Palm oil is a common ingredient in detergents. Credit: Jordan Goebig, Institute for Sustainability, Energy, and Environment  
BELOW: Palm oil-related deforestation in Riau, Sumatra. Credit: Flickr

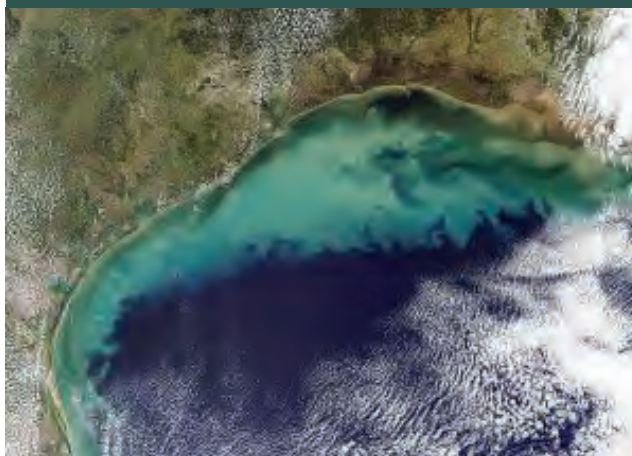


sion, every three to five minutes during daytime programming, is no joke, either! A dish commercial — mom and germs. A laundry commercial — mom and germs. A toilet cleaner commercial — mom tackling those germs.

Back in the rainbow aisle of the supermarket, I strike up a casual conversation with a lady with two children in tow. We each conduct a stringent sniff test to make our respective decisions about which dish soap smells the cleanest. For me it's the candy lemon fragrance of Dawn Ultra Concentrated. For her, it's Ajax's Grapefruit Antibacterial. She points at the kids, and responds with one word, "bacteria." It's an exchange I've had in various settings repeatedly with moms over the last 20 years. However acute my sense of smell might be, it was a faulty test for detecting the petroleum, FD&C Yellow 5, or methylisothiazolinone. Nor was I able to determine by whiffing away that my soap selection contained ingredients that have skin and breathing allergens, show high toxicity to aquatic life, and are not anaerobically degradable. The Environment Working Group (EWG) gives this product a D. EWG rates thousands of consumer products based on ingredients whether they are good or bad for the environment and compile a database for anyone to access. Yet, I had never heard of this until taking an environmental writing course.

I have seen such slimy manifestations in local water spots like the public beach near the Clinton nuclear power plant. Each summer our church is given access to a private beach area very near the plant, and last summer I recognized an algal bloom just outside the buoyed-off portion of beach. It was a small patch, and a research dive into any reports or warnings regarding swimming there could not be found in the last eight years. I witnessed another bloom where the water surface was almost completely covered at a city pond. Our local cross-country race course has athletes running along the pond edge during home meets, and I have spent a decade watching my kids run there. Last year was the worst I'd remembered. Both bloom sightings were in late August, when summer heat forces fish to seek the deeper, cooler regions of a body of water, and where oxygen is already lower than at the surface. While no public warnings have been made or reports of mass graves of floating fish, the smelly slime I saw there is framed with this greater image of hypoxic conditions on a bigger scale.

Hypoxic zone in the Gulf of Mexico. Credit: Wikipedia



My bottle of soap with its elegant design and promises of a more sanitary home captures me with its eye appeal. Major players like P&G, Colgate, and Unilever have mastered what the French call *jolie laide* — beautiful ugly — in this everyday commodi-

ty. "About 76 percent of the phosphorous in detergents, 370 million pounds of it, ends up in surface waters, and the problem is getting worse," according to an article on dirtdoctor.com. What we get enchanted with in our respective supermarkets comes from one of some 20 or so manufacturing sites in the United States. Half of these line the Eastern coastline. Another eight factories are along major Midwest waterways, like the Mississippi River.

Phosphates from sewage effluent going down our drains are a significant part of what is fueling hypoxic dead zones, as large as 8,000 square miles, in the Gulf of Mexico last year. The Mississippi River/Gulf of Mexico Hypoxia Task Force was formalized under the Harmful Algal Bloom and Hypoxia Research and Control Act of 2014, and now reports under the umbrella of the U.S. Environmental Protection Agency. The task force figures in a 2017 congressional report showed phosphates from all freshwater sources were at their second-highest amounts in four decades of tracking — 200 metric tons, getting into the Mississippi River. For comparison's sake, Chicago's Cloud Gate sculpture (aka The Bean) is made of 110 metric tons of liquid mercury.

P&G has another problem to contend with as well: palm oil. It's a common ingredient in detergents. Bustar Maitar, a writer on Greenpeace's website, makes the accusation that every time we reach for that bottle of soap, "Proctor & Gamble are making us part of their scandal." Greenpeace reveals findings from a yearlong investigation in 2013 that shows P&G is sourcing palm oil from companies connected to widespread forest devastation.

Palm oil by itself is not necessarily a threat, but so-called "dirty palm oil" — from forest destruction — is. Expansions of oil palm plantations are destroying forest habitats, and although P&G doesn't harvest there, it contracts with law-breaking corporations who take no moral issue with their own practices of making a buck, according to Greenpeace. The organization also found that orangutan habitat was being cleared in plantations linked to P&G's supply chain, and that forest fires and habitat destruc-

Carin Cone, U.S. Olympic swimming star and housewife, says: "I was ashamed of my hands until I changed to Thrill."

**ONE BOTTLE WORKS MIRACLES**  
...even on water-red water-rough water-chapped hands.

Today's Thrill with amazing THERATONE... milder to hands than any other leading dishwashing liquid!

Read how changing to Thrill, with the amazing discovery Theratone, gave Carin Cone lovely hands in 14 days.

"I practically lived in water to win my Olympic medal. When I got married, I found myself living in dishwater. It dried my hands worse than swimming. Many were really rough and flaky. So I was a good one to test Thrill." Carin and 10,000 women tested leading dishwashing liquids and proved Thrill with Theratone is milder to hands than any other.

"Right off, I could feel the difference in the detergent. It seemed soothing. You can actually feel the difference Theratone makes. It gives dishwashing a soothing feeling you've never known from any other leading liquid."

"Changing to Thrill sure worked. In just two weeks, my flakiness and roughness were gone. I was shocked silly. Now my hands stay nice through swimming, dishes and all." Switch to Thrill yourself. Say good-bye to old-fashioned liquids and rough, red hands. One bottle works miracles!

tion are pushing the Sumatran tiger closer to the brink of extinction. So, while my wonderful children won't get skin blisters or diarrhea from the palm oil in our dish soap, the environmental impacts associated with its production begin to churn my stomach.

There isn't much talk around my central Illinois farm town of Monticello about this "dirty" side of dish soap. Am I, like so many other moms here, distracted by the pretty packaging, clever marketing, convenient costs, and alluring aromas? There is probably a good deal of "yes" in my answer to that question, but the manufacturers aren't held to a standard of transparency about their ingredients, either. The 1976 Toxic Substances Control Act was created as a way to regulate the introduction of new commercial chemicals and their use. What it didn't require was for cleaning products to list all of their ingredients, and many manufacturers opt not to do so — as was the case with Dawn's use of petroleum, mentioned earlier.

With profit margins in the billions, P&G made \$671,000 in political contributions in 2016 — 51% of that to Republicans. Coincidentally, this was the same year that, the "Frank L. Lautenberg Chemical Safety for the 21st Century Act," was expected to gain Senate approval and President Obama's signature. With an estimated 700 new chemicals coming into the market each year, this proposed law would require the EPA to regulate household products that are now sold, and any new ones. Additionally, it would require higher standards for protecting "vulnerable populations." Another \$3-4 million was spent by this detergent giant to lobby and block any bill that would require transparency of the ingredients they are using.

For two decades I've been immersed in a middle-class, mom-driven lifestyle, where information came more from

who has found the latest convenient products at nominal cost, than it did from the conscious search for products that were eco-friendly. If the label said "concentrated" or "kills 99.9% of germs," all the better. Over that time, I'd attend the occasional party, where usually some perennial mom among us would go all-in on some home-based business that sells an extensive line of organic, non-hazardous, toxin-free cleaning products. Most who tried ended up back at the grocery store within a year. P&G knows this, too. Even though consumers have raised purchases of more environmentally friendly cleaning supplies another 10% this decade, most are still looking for a value and haven't made it out of their "sanitary bubbles."

Under the powerful magnification of a microscope's lens, kaleidoscopic patterns of nacreous colors form around a dark eye — almost with the effect of a psychedelic tie-dye pattern swirling down a drain. A soap bubble, so beautiful, yet so toxic. Its deception almost a masquerade, when you add a citrus scent. Like all things that we give loyalty to, it's not an easy thing to just give up. I sit with this captivating image of a soap bubble after watching a TED Talk given by Lauren Singer, a twenty-something who lives a zero-waste lifestyle and blogs about it. She also started a company that makes eco-friendly, zero-waste cleaning products, among other things.

Another mom I see in circles around town recently gifted me with a jar of homemade soap she made from a recipe she found on Pinterest. I wonder if the marketing strategies of bloggers and hobbyists will compete with the sanitation brigade cheering at the next soccer meet. For my part, convenience and cost will probably continue to drive my buying decisions — just as all the predictive models suggest. Still, the weather is finally warming up, and summertime encounters with algal blooms in our favorite water spots might, just might, have me willing to pay a little more for a sparkling clean conscience.



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completing her Ph.D in English/Writing at the University of Illinois. This article was written for ESE 360, the introductory CEW course, in Spring 2018.





San Juan residents pick through the wreckage left by Hurricane Maria.  
Credit: Roosevelt Skerrit



The author collects water samples.  
Credit: Mark Healy

# SAFE TO DRINK?

By Mark Healy

On Sept. 20, 2017, Hurricane Maria made landfall in Puerto Rico, producing sustained winds up to 155 mph. As the twisting gale of the Category 4 hurricane ripped through lush green canopies, mountain creeks swelled into gushing rivers, producing catastrophic floods that devastated communities throughout the island. When the storm finally cleared, Maria was classified as the 10th strongest hurricane on record, and the third-most expensive in U.S. history.

The island's power system was absolutely crippled; not a single one of Puerto Rico's 3.4 million energy consumers had access to the electricity grid in the immediate aftermath. Repair needs would be extensive, with 80% of power lines severed by winds or falling branches.

Less obvious than the loss of power was the rapidly deteriorating water supply, which threatened a humanitarian catastrophe in the island's remote communities. Five months after the hurricane hit, I traveled with a group of fellow engineering students to Maria's "ground zero" to see for myself what engineers could do to help the water crisis. As it turned out, Puerto Rico's problems were as much political and cultural as hydrological.

As the first rays of morning sunlight clipped across the green hills of central Puerto Rico, our convoy of black SUVs rolled south toward home base in Ponce. After a long night of traveling, weary-eyed students laid their heads to rest on the windows, while my eyes were fixed on the spectacular landscape. I avidly took in the island's natural beauty: orange flowers blooming high above the forest canopy; expansive valleys bordered by rocky walls;



A young boy waits in line for water after Hurricane Maria. Credit: U.S. Army National Guard

brightly colored homes straddling gushing creeks. However, evidence of a catastrophe was also readily available. The same creeks were filled with debris, from twisted tree branches to rusting car parts. Homes were topped with blue tarps, their corrugated metal roofs ripped off in swirling winds. The central highway we drove along was lined with the mangled pieces of fallen street signs.

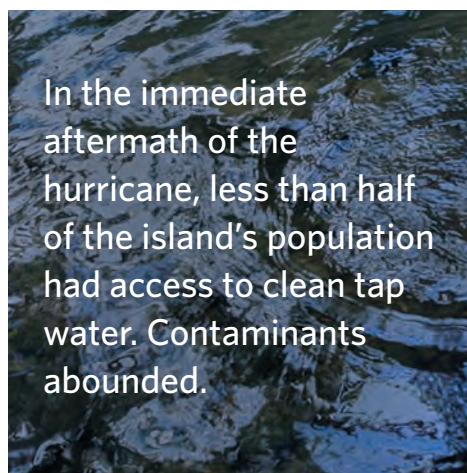
“Just after the hurricane, there were no leaves on any of these trees,” our guide said as we bumped along the empty road. “The winds ripped them all off. The land was brown, the ugliest I’ve ever seen Puerto Rico.”

In the half-year since the storm struck, the island’s beauty had revived, but recovery efforts for the island inhabitants were crawling along at a snail’s pace. In the immediate aftermath of the hurricane, less than half of the island’s population had access to clean tap water. Contaminants abounded. Sheet metal structures throughout the island had been scalped, depositing corrugated roofs into stagnant pools. The abundance of blossoming foliage shaded mounds of garbage still left uncollected adjacent to water sources. Although bright green leaves everywhere indicated nature’s revival, many Puerto Ricans were still struggling to find clean drinking water.

After a few precious hours of sleep in Ponce, our team of engineering students set out for our first testing site, a remote little town named Sierritas. Located just kilometers from the highest peak in Puerto Rico, Sierritas’ name — “little mountains” — comes with a hint of irony. As our guide thwacked through a

dense forest of sugar cane, vines, and roots, he offered a detailed introduction to the island’s water infrastructure. Residents told us that a municipal water company known as PRASA supplies treated water for a price of about \$13 per month to communities around major cities such as Ponce, Mayaguez, and San Juan. However, homes in more rural locations or higher up the mountains rarely receive PRASA service. Only 10% of families that we spoke to during our time in Puerto Rico had access to PRASA water. Instead, many families received water used for daily tasks such as cooking and showering from shallow pools constructed generations ago.

Having stumbled along the narrow mountain path for what felt like an eternity, we arrived at the source pool for the water used in Sierritas. Water trickled over shaded rocks, collecting in a large basin. A long white pipe pointed between two rocks drew in water before snaking down the mountain to the village. All that prevented detritus from clogging the pipe was a grated cap, coated with leaves and cleaned by hand once every two weeks. Sweat dripped down our faces as we set about our assigned



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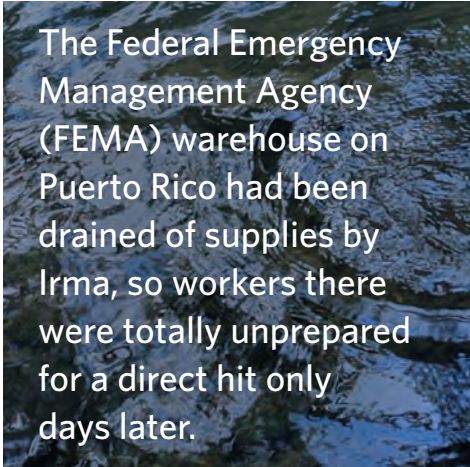
tasks. Sample vials were filled from the pool, reagent powder packets were emptied into the vials, and machines cast beams of light through the tinted water: all in an effort to determine the concentration of toxic metals in the water. Within minutes, students were reporting numbers that raised concern for the water quality of Sierritas. Testing revealed high levels of suspended solids, indicative of particles floating within the water. Although these particles might be innocuous, they

could also disguise pathogens that cause diarrhea and severe dehydration.

We filled plastic jugs with gallons of water to lug back to a laboratory for further testing. On the other side of the pool, tests revealed the presence of the heavy metal manganese. Manganese concentrations were likely boosted by disturbances in creek soils due to the heavy rainfall that accompanied Maria. The impacts of manganese pollution might not appear for many years in the local population, but prolonged manganese intake, by damaging the central nervous system, can lead to developmental disabilities in children. Manganese is regulated by the EPA's secondary drinking water standards but, even before Hurricane Maria, just 30% of Puerto Rico had access to water that complied with the Safe Drinking Water Act of 1974 — a water quality disparity that would become even more apparent as our testing continued.

Maria truly was a perfect storm. Just two weeks before it hit Puerto Rico, Hurricane Irma had pummeled the Caribbean. The Federal Emergency Management Agency (FEMA) warehouse on Puerto Rico had been drained of supplies by Irma, so workers there were totally unprepared for a direct hit only days later. Puerto Rico's ambiguous political identity amplified the damage of the hurricane double whammy: As a territory of the United States but not a state, Puerto Rico's access to resources after a natural disaster is hampered by red tape.

Most notably, the Jones Act necessitated that all shipments to the island be carried by U.S.-built and -operated

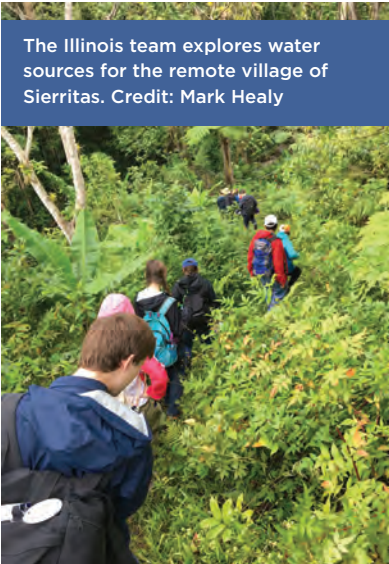


The Federal Emergency Management Agency (FEMA) warehouse on Puerto Rico had been drained of supplies by Irma, so workers there were totally unprepared for a direct hit only days later.

ships (although Puerto Rico was given a waiver for the act shortly after Maria). Furthermore, transportation infrastructure on the island made distribution of goods from ports extremely challenging, creating supply bottlenecks. These logistical challenges were best highlighted by the revelation in September 2019, exactly one year after the storm, of 20,000 pallets of water bottles left undistributed on an airport runway. With debris strewn throughout the countryside and

floating in pools that fed rural water supplies, this bottled water could have provided critical relief for thousands of desperate Puerto Ricans, but went unused due to failures in emergency management and communication.

Back at our hotel in Ponce after our first day, tests on the gallons of water carried away from the field site revealed more health threats for the residents of Sierritas. Biological samples confirmed the presence of bacteria, including *E. coli*. A *Leptospirosis* outbreak in Puerto Rico in the aftermath of Hurricane Maria had left at least 26 dead, but clearly, the freshwater emergency wasn't over. For U.S. citizens in most of the mainland,



The Illinois team explores water sources for the remote village of Sierritas. Credit: Mark Healy



Long lines for water have been a common sight in Puerto Rico, even months after the hurricane hit. Credit: Puerto Rico National Guard

“No hurricane can stop us.”  
Credit: Wikipedia



such bacteria are typically neutralized during disinfection processes. But not in Sierritas. The lack of treatment processes that we take for granted was proving deadly for far too many Puerto Ricans.

With Maria’s devastation amplifying existing poor water conditions, drastic steps are needed to improve the struggling island’s water quality. Nongovernmental organizations such as Oxfam have stepped in to provide household-scale water filters. Oxfam extensively distributed “Big Berkey” water filters to affected communities.

These filters have a capacity of 2.5 gallons and are kept in household kitchens. But the Big Berkey filter costs more than \$250, and its replacement filtration unit is \$120 — prices prohibitive in disadvantaged communities, where the average weekly wage is \$500 or less. While the work of NGOs in providing the Berkey filter as a stopgap solution is significant, there must be a longer-term plan as the lifespan of the filters expires.

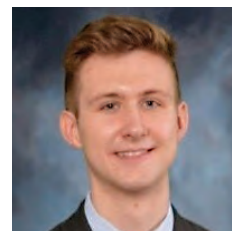
A strategy must be developed to ensure a resilient water supply capable of withstanding the inevitable natural disasters, and political disruptions, of the future. Resiliency could be improved through the expansion of PRASA distribution networks, but this is a process that will take significant time and investment. The first step is ensuring that targeted consumers are on board and educated about the benefits of fully treated water. Many consumers in disadvantaged communities are averse to the taste of chemicals added through treatment processes by PRASA. Even before Hurricane Maria, residents of the mountains of Puerto Rico, such as the villagers of Sierritas, have not been exposed to chlorine and are thus not as accustomed to its taste.

To start a new trend of acceptance for chlorine disinfection, educational programs on its effectiveness should begin immediately. Pamphlets from PRASA and NGOs as well as instructional visits from water professionals could begin to build a positive association in islanders’ minds between the presence of chlorine and the absence of dangerous pathogens. Discussions in school classrooms would encourage students to pass along information about clean water to their parents and promote safe drinking water awareness among the next generation. Over time, a wave of acceptance for engineered water treatment could sway community leaders to seek municipal connections to PRASA systems, laying the groundwork for mountain communities in Puerto Rico to access safe, regulated water. Practicing water treatment techniques in the villages consuming the water will improve trust in the processes by bringing the actual technology, and not just the finished product, to the residents.

Puerto Rico’s rough topography adds to the challenge, making it difficult to connect homes to the existing water distribution network. The great elevation differences between a mountain community such as Sierritas and a treatment plant in the valley below would require expensive and energy-intensive pumping to provide water at the same pressure at the two locations. As such, one solution is to center treatment facilities for mountain villages in the communities themselves. An added benefit to opening new water treatment

facilities in remote areas would be the creation of jobs and expertise in the water industry. Systems could also be constructed with emergency interconnects, where water could be shared between villages in the event of damage to a treatment facility during a future disaster.

A year after Hurricane Maria, many residents of Puerto Rico’s central regions still draw water from sources contaminated by the storm’s destruction. These soluble remnants are strained by household filters supplied by non-governmental organizations. In the face of future Marias, a focus on resilient infrastructure is needed to shift treatment procedures from reactive to proactive. Any improvement to Puerto Rico’s water infrastructure will require significant and continued investment. While the island’s energy concerns were highlighted after Hurricane Maria — and even addressed somewhat by celebrity donations and Tesla battery packs — water quality issues received very little publicity. Drawing attention to water rights for the U.S. citizens in Puerto Rico is a crucial step in bringing these mountain communities water that they can trust won’t kill them. Even in my few days experiencing the water crisis in the central highlands of Puerto Rico, the staggering inequities between water quality in Sierritas and what we are accustomed to on the U.S. mainland were crystal clear. Although the terrifying winds of Maria have passed, the winds of change still need to blow across Puerto Rico.



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engineering consultant for Trotter and Associates Inc. in Chicago. This article was written for ESE 360, the introductory CEW course, in Spring 2018.



# A Clear Message

By Taylor Jennings

At the end of the day, what truly mattered was not just providing water, but empowering the people who would drink it.

**W**e all took turns running our hands under the gurgling water coming from the outtake pipe at the end of the biofiltration sand filter in the little village of Las Mesas, Honduras. The sedimentation tank sat unused as water rushed through the bypass pipe. A faded World Vision logo adorned the side of this \$500,000 system, a fitting symbol of a well-intentioned failure. The engineers who designed this system had blown through this village a few years ago, never to return. But for the residents of Las Mesas, the broken water treatment system in the middle of town would be a daily reminder of what happens when you put your trust in strangers.

Our goal in visiting the nearby village of El Tablón was to avoid this outcome at all costs. With the help from local grassroots organization ADEC (Agua y Desarrollo Comunitario), the community of El Tablón, and professionals in the field, my classmates and I were about to embark on a development project of our own.

Traditional international development is broken and has been for a while. Again and again, the same pattern

Pictured above, credit: The Eldridge Family

follows: engineers go into a community, survey the area, and develop a design, while locals stand by expectantly awaiting the solution. When it comes to supplying fresh water, outsiders tend to show undue faith in silver bullet hydrology, which doesn't take into consideration the daily routines and cultural practices surrounding water use.

We began our trek up a darkened volcanic hill with our guide, Isadora, leading the way to the remote village of El Tablón. You couldn't find this community on a map if you looked with a microscope. Communities in rural Honduras

Illinois students and ADEC learn the history, and failures, of the Las Mesas water treatment system. Credit: Carly Sandin



## When it comes to supplying freshwater, outsiders tend to show undue faith in silver bullet hydrology, which doesn't take into consideration the daily routines and cultural practices surrounding water use.

aren't formed by city planners; they evolve naturally. We made our way from household to household crawling through barbed-wire fences, hopping over wooden gates, and sometimes stopping in luscious green fields for fresh strawberries.

Our team was a motley crew, consisting of one skilled Honduran local, one soft-spoken graduate student acting as our translator, and four Illinois undergraduates more or less out of their depth — myself included. Spanish has never been my strong suit, which is why I could not have been more thankful to have our translator, Bernardo Vazquez Bravo. All day, he patiently listened to El Tablón residents discuss their problems with inconsistent water access.

As we approached our first house, I felt a mixture of excitement and low-grade panic. I had been told horror stories of communities whose faith in development aid had been broken by projects like the failed World Vision system nearby in Las Mesas. But I could not have been more pleasantly surprised to find two giggling women sitting on the front porch. We might have been outsiders, but we quickly realized the power of a smile and a wave in our interactions with the locals.

More than just speaking the language, intercultural communication is a performance. This became evident as we all stood around on the porch giving each other expectant glances, while one woman lounged in a hammock and the other rested on the steps.

"So, what do you use the water for? How much do you typically use in a day?" Maddie Brinka, a member of my group, asked the women as Bernardo translated. I did the work of furiously scribbling their responses in my flower-adorned notebook. At first, the two women turned to each other to laugh awkwardly, but you could tell their responses were serious and thoughtful. Often you have to evaluate who's saying what, and more importantly, the reason they're saying it. This is when it dawned on me: the importance of creating trust. We needed community members to see us as friends, and not just strangers passing through, as was the case in Las Mesas.

We became a part of the El Tablón community for a week. From day one, we ate breakfast, lunch, and dinner in their

homes. We played with their children and socialized with their spouses. We even had the opportunity to attend church alongside our neighbors, who treated us with real kindness. On day four when I, and some others, started to feel sick and gave up eating, Magdolina came to our rescue like any good grandmother would, offering to cut up fresh watermelon and strawberries. She treated me with the same tenderness she offered her rambunctious grandson Emerson, whom you could often find chasing the family chickens while we lounged in dust-covered lawn chairs outside his adobe home. Emerson, like his grandmother, was always just as excited to see us as we were him. Each morning, he would stand next to the family's truck and wait for our arrival, at which he would bolt back inside and alert the family. It only took us a couple of visits to start feeling like we were a part of the family.

The new filtration system in El Tablón was going to be gravity-fed, as this was an inexpensive, reliable source of energy. With just a little PVC piping and concrete, there would be a functioning water system in no time. This also meant that community members wouldn't have to pay fees to maintain an electric pump. And for families like the Sanchezes, this was a crucial part of the design. As we stood on their porch, 92-year-old Roberto told us how thankful he was to still be alive and to have the ability to work the field, which surprised me given his cataracts, missing teeth, and general deafness. This didn't seem to bother his wife Maria as she interpreted for her husband, all the while shucking corn. The family didn't have enough money to get on the electrical grid when the German engineers came into the community a couple of years back. Roberto and Maria proceeded to tell us that times had gotten tougher in their old age and, after the death of their son, they just didn't have the money to participate in the program. Feeling both heartbroken and inspired by the strength of this family, I waved to their 9-year-old granddaughter as she peeked around the corner of the porch, not sure who we were or what we were doing at her grandparents' home. Isadora motioned for us to follow, as we worked our way down the mountain to the water wellspring.

Flow rate is a vital consideration when trying to provide drinking water for an entire community. To be reliable at all times of the day, the source not only needs to have a

Members of the Illinois team on their walk through the village. Credit: Carly Sandin



The University of Illinois student group takes measurements and collects data. Credit: Alexander Lopez



The deteriorating Las Mesas water structure: a relic of fly-by development. Credit: Taylor Jennings



high flow rate, but the storage tank has to be large enough to compensate for flow deficit. Luckily, a source had been identified that had sufficient flow rate to do just that. Every morning, those living in the lower reaches of El Tablón could fill their “pilas” — household water catchment tanks — regardless of whether those at higher elevation had already collected their water. No longer would the Sanchezes have to turn on their tap not knowing if they would be greeted by the gurgling of water or deafening silence.

This good news came with a setback requiring some delicate diplomacy to overcome. Villagers themselves had identified another water source and were excited to use it, but upon inspection by our team, the same results wouldn't yield: It just didn't have enough water or pressure. This was a critical moment in our relationship with the community. Would our mutual trust survive their disappointment? We scheduled a meeting with the local water committee to discuss our findings.

As all parties — the water committee, ADEC, and our traveling group of engineers — sat down for a meeting at the Water House, an awkward silence fell upon the group. We had to tell the committee that we couldn't use their new source and that concrete would have to be used in construction — another concern the locals had. But in a country where high-tech materials aren't an option, concrete was our only choice. I, along with most of the students, sat under a tree outside the house while the meeting was conducted. Instead of overwhelming the seven members of the water committee with 20 foreign faces, we decided that a chosen few of the students should speak on behalf of all of us.

As the dialogue alternated between English, Spanish, and engineer-speak, tensions relaxed. Bernardo, our translator, explained in a calm and trustworthy tone to everyone that plans would have to change. Claudio, the water committee president, wearing a large, white cowboy hat, nodded in approval. You could tell, even from a distance, that Claudio appreciated being involved in the discussion. Despite his disappointment in not being able to use the source he had found, he respected our opinion and knew that we wouldn't make the same mistakes for El Tablón that others had made for Las Mesas. Expectations would have to be modified, but the needs would still be met. Taking it in good grace, all parties agreed on what had to be done. Everyone shook hands, and the green light was given.

What did I learn from my week in El Tablón? The concept of development needs to be modified. The goal of these projects should never be about “developing” a place with top-down management. After my return, thousands of miles away in an office in the Department of Civil & Environmental Engineering at Illinois, I could hear the gurgling

The author Jennings (bottom row, third from left) with her study abroad cohort. Credit: Alexander Lopez



of a mechanized water pump giving life to a houseplant soaking up the sun in the window of Ann-Perry Witmer's office. An expert in the cultural dimensions of engineering and leader of Engineers Without Borders on campus, she explained the new framework for international development projects: “We don't go in with the idea of making the community look like us; we help make the community look more like them.”

Once you start introducing the lofty, abstract goals of development, like equity, alleviating poverty, and creating world peace, the process becomes over-complicated, she said. “It muddies the water so much that you can't do the basics, and projects are destined to fail. You can be the smartest technical person in the world, and you take one little left turn socially or politically, and everything just goes to hell.”

In the brave new world of development, clever design and cultural communication go hand in hand. For me and my fellow students in Honduras, the water project at El Tablón was never just about just the system. It was also about getting to know a world outside our own, immersing ourselves in the unknown, learning to sink or swim. At the end of the day, what truly mattered was not just providing water, but empowering the people who would drink it.



Taylor Jennings is from St. Louis. She received a B.A. in English and a B.S. in Global Studies in May 2019. She became involved with the Honduras Water Project her sophomore

year and has since continued her work at the nexus of culture and engineering with the organization Akelos. This article, based on fieldwork in Honduras, was written for ESE 498, the CEW capstone course, in Spring 2018.

**“We don't go in with the idea of making the community look like us; we help make the community look more like them.”** Ann-Perry Witmer



Living World

# Where the Buffalo Roamed, Disappeared, Now Roam Again

By Jenna Kurtzweil

Credit:  
Shutterstock

**B**ronze looks strange on a bison. I regarded the sculpture before me with a mixture of awe and skepticism as I awaited my parents outside the Prairie State Grill. The restaurant was the first pit stop along my family's road trip from Illinois to Arizona, and its mascot — the bison — loomed large and lifelike before my 8-year-old eyes. Built on a rapidly developing stretch of grassland, the greasy eatery boasted prime real estate with a Wild West motif to match.

Given the historic association between American bison and western imagery, the restaurant's choice of mascot was not surprising. And although the tavern's guardian was majestic in its own statuary way, it was a far cry from the buffalo that thundered through my imagination, and that had once dominated this prairie. While the creature's nose appeared dewy with moisture and its flanks were chiseled to mimic flesh and bone, its hooves remained welded to the platform on which it posed, and even the most persistent summer breeze couldn't ruffle its metalwork hide. Something about seeing a bronze bison rather than its living counterpart upset me. A question haunted me on meeting the creature's copper-plated gaze: How can we create restaurants dedicated to honoring bison while simultaneously destroying the creatures' historic habitat?



An answer to this complex question demands an understanding of the bison's checkered natural history. What, exactly, did the buffalo's home look like? How did it feel to stand in this spot thousands of years ago, when bison reigned and the landscape wasn't yet cloaked in concrete highways and fast food strip malls? I closed my eyes, pretending that the nearby traffic's rumbling was the thundering of a thousand distant hooves. In my mind, I was on a journey to the distant past, a pre-industrial paradise of bison coexistence and ecological harmony.

But the bison's role in the North American narrative is far muddier and more turbulent. While bison are largely perceived as quintessentially "American," the species did not originate on the North American continent. DNA-based evidence uncovered in 2017 proves that the first bison migrated to North America 130,000 years ago via the Bering Land Bridge. Now fully submerged, the land bridge once connected East Asia to modern-day Alaska's western coast.

Despite the variety of grazing megafauna already present in North America, bison thrived, increasing their range of distribution even as mammoths, ancient horses and giant sloths dwindled. Scientists today conjecture that the bison's infiltration of the North American prairies is directly responsible — in conjunction with human involvement — for the extinction of prehistoric megafauna. For this reason, the bison's establishment in the Americas is technically classified as an invasion rather than a migration.

Contrary to popular myth, the bison's transformative impact on the pre-existing American ecosystem is outdone only by the wave of destruction brought by humans thousands of years later. Following their North American invasion, bison spent millennia evolving and honing the necessary traits to retain dominance. At the 15th century's close — just as Columbus made his historic landfall — North America housed upward of 30 million bison, distributed across the Great Plains from Idaho to Pennsylvania and up into Canada's southern provinces. Although bison had been hunted for about 12,000 years, the Native Americans' largely sustainable practices posed no lasting threat to the species' survival. Similarly, wolves and grizzlies (the bison's only natural predators) never made a significant dent in the population. It's not hard to believe, then, that North American bison remained stable for millennia, and herds numbering in the millions trekked their circular migration patterns — spending summers up north and moving south for the winter — year after year.

Back at the Prairie State Grill, the nearby rumble of traffic lulled for a moment, and the silence jarred me back to my bison-free reality. People chattered inside the restaurant, the grasses whispered and waved, but nothing thundered on the plains. As my family motored west, sightseeing opportunities became limited to vultures circling overhead, the occasional anomalous rock formation, freight trains streaking along distant tracks, and, of

course, the free-range cattle that roamed the prairies in droves. I could hardly believe that scarcely two centuries prior, bison populated the plains just as abundantly as beef cattle do now.

Evidently, early colonizers shared my incredulity, and equated the vast multitudes of bison herds with what they believed to be a boundless supply of resources available in the American West. They wasted no time in tapping these supposedly infinite riches. Along with the harvesting of corn, tomatoes, and potatoes from the New World, bison were coveted by European traders for their hides, meat, and various organs harvested in their own right.

The Nature Conservancy chronicles the catastrophic fallout of the European bison trade, highlighting the fact that "unlike the Native Americans who utilized virtually all of the bison ... white hunters became extravagant and wasteful. Taking only delicacies like the tongue, they left tons of meat and hide to rot." The number of slaughtered bison during this period was so astronomical it was said that one could "walk ... 100 miles along the Santa Fe railroad right-of-way by stepping from one bison carcass to another."

American settlers embraced bison hunting with such zeal that its status quickly shifted from trading commodity to popular recreation. A particularly gruesome hunting exercise involved targeting herds from the windows of moving trains: the thousands of bison gratuitously slaughtered in this manner were never used in any way.

This bison-hunting mania was further fueled by widespread white antagonism toward Native American tribes, when the colonists' fervor for sport-hunting converged with a genocidal agenda. By purging the tribes' primary food source, settlers were able to weaken and exploit the Great Plains native communities.

Buffalo statue in Kearney, Neb.  
Credit: Wikipedia



Eventually, these horrifying tactics, which began as carelessness and ended in pointed aggression, took their toll: Over the course of the 19th century, a staggering 50 million bison were slaughtered. In the biologically brief span of a single century, 12 millennia of population growth unraveled, and the creature that had outlived woolly mammoths and saber-toothed tigers was brought to its knees by humans with barely a second thought. At the turn of the 20th century, fewer than 600 bison resided in the United States, just over half of the world's total population. In 1889, the American public faced the alarming reality that more than 99 percent of the world's bison population had been eliminated since the days of Columbus and, as is often the case, imminent catastrophe proved highly motivating.

For better or worse, the bison's scrape with near-extinction acted as the catalyst that transformed Americans from primary predator to staunch defender, even worshiper, of the bison. Beginning with the termination of commercial bison hide shipments in 1889, activist groups rallied around the creature that had been recently destroyed so mercilessly. The American Bison Society was founded in 1905 with the mission of reviving the species, and a bison adorned the back of the American nickel from 1913 to 1938. Through a mixture of activism, legislation, and privately and publicly managed herds, the population climbed to the tens of thousands by 1935. The American Bison Society, believing its mission accomplished, was promptly disbanded.

Bison remain symbolic of western freedom in the 21st century. Currently, the U.S. is home to roughly 350,000 bison split between private and public herds, the largest population since 1889. The year 2005 was noteworthy on multiple fronts as it witnessed the reincarnation of the American Bison Society as well as the revival of the American Bison Nickel, and in 2016, President Obama introduced legislation establishing bison as the national mammal.

As time goes on, bison continue to be beloved by the American public and protected by increasingly strict laws. However, they remain alienated from the symbols of freedom that the original European settlers associated

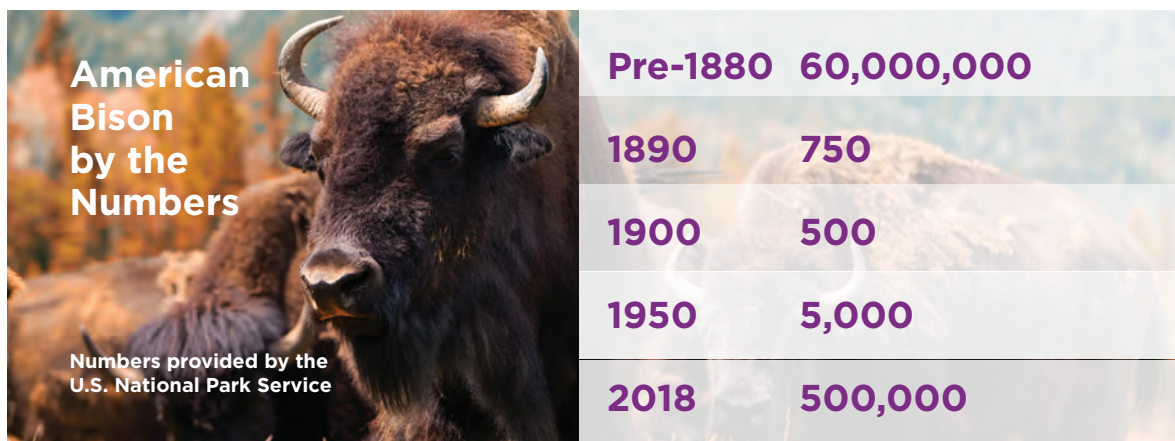
them with. Bison roaming today's grasslands differ from their ancestors in terms of lifestyle, ranging territory, and even genetic makeup. During the species' most drastic population shortage in the late 19th century, they were often bred with cattle by ranchers looking to stabilize profit margins.

Today, American bison have escaped the threat of extinction, largely because of human intervention and population engineering. Humans continue to exert their godlike powers of selection, but with the intent to preserve rather than to profit.

In Oklahoma's Tallgrass Prairie Herd, for example, health and wellness data from the herd's 2,500 bison are strictly monitored. While this close supervision is intended to protect, it showcases the meddlesome, even compulsive character of human intervention. It likewise prompts the unsettling question every environmentalist or mere bison-lover needs ask themselves: Is it that we humans can only operate in extremes — whipsawing from mass extinction of the bison to genetically optimized reintroduction in a few short generations — while ignoring all possibilities for retreat, to allow nature to take its course?

In the least flattering light, the bison's reintroduction to the American prairie might be considered an egotistical effort to assuage our collective guilt and reinhabit an idealized past. However, a less damning interpretation might acknowledge that in addition to providing us with a conservation success story, bison work wonders upon the American grassland. Bison are "selective grazers:" they gravitate toward dominant grasses, eating only those varieties that provide necessary nutrients, thus leaving less dominant species to flourish.

Additionally, bison are more sustainable grazers than cattle because they don't eat grass completely to the ground, instead opting to shear off the top layer. This eating pattern allows the foliage's lower levels to access more sunlight and results in the plain landscape's close-cropped appearance. Early American explorer Meriwether Lewis commented to this effect in a journal entry dated July 17, 1806: "... the grass is naturally but short and at present has been rendered much more so by the grazing





Pile of bison skulls, 1870s.  
Credit: Wikipedia

Credit: Shutterstock

of the buffalo, the whole face of the country as far as the eye can reach looks like a well shaved bowling green, in which immense and numerous herds of buffalo were seen feeding ... "

This excerpt from the iconic diaries of Lewis and Clark not only acknowledges the bison's ecological impact, but helps us imagine the historic prairie landscape with first-hand clarity. Perhaps the idealized image of bison herds blanketing green hills is not too far out of reach after all. The idea of reintroducing "buffaloe" to the grasslands in which they evolved is taking America by storm.

South Dakota's Cheyenne River Ranch, run by Dan and Jill O'Brien, is a prime example of this agricultural shift. Having formerly managed beef cattle, the couple claims that their conversion to bison conserves resources that would otherwise have been devoted to keeping their herds well-fed and protected from the prairie's harsh environment. While beef feedlots generate large quantities of chemical waste and non-organic contamination, the presence of bison on the prairie is virtually waste-free, proven to be sustainable through millennia of evolutionary refinement.

Speaking for a community determined to restore native creatures to native lands, Dan O'Brien passionately states that "what really needs to be out on the Great Plains ... (are) the indigenous animals." His powerful statement recalls the question that I agonized over at the Prairie State Grill: How can we justify displacing bison in order to construct bison-honoring restaurants, structures, and shrines? Bison imagery, it turns out, is not limited to restaurants at all, and can be found almost anywhere from the prairies across the plains: neon bison blaze down from billboards, while bison sculptures of every imaginable material — including bronze — populate antique stores. Even charming bison illustrations doodled cartoonishly on the fringes of menus are not uncommon, as my 8-year-old self can sheepishly report.

Bison, as at the Prairie State Grill, are both everywhere and nowhere. And how different, really, is the bronze bison from the herds roaming North America today, most of which wouldn't exist without some form of human engineering? They are a form of "built bison," sculpted not from bronze or copper, but from a collective human effort to restore that which was destroyed. Why do we do this? Is it a pure show of power, a deep yearning to return to the past, or a lingering unease about the fallout of American settlement? Perhaps it's a combination of all three.

That said: Yes, the reintroduction of bison is an unparalleled victory of conservation, and the environment will be better for it. And yes, this reintroduction is being conducted entirely on our own terms. Celebration is definitely in order, but we must proceed with caution. After all, while bison might today appear docile to our uses, they are still descended from the heroic species that survived the Ice Age and outlived the woolly mammoths.



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Waste Not

# THINKING IN CIRCLES SAVES THE WORLD

By Laura Schultz

On Jan. 1, 2018, the People's Republic of China stopped accepting shipments of used waste plastics from around the world. Though it made some headlines, this about-face didn't turn the world as we know it on its head — or at least it hasn't yet. As far as most of us knew, in the first week of 2018 we dropped our garbage in the trash can and our recyclables in the recycling bin, and they went to the same places as the week before.

Up until January 2018, China processed about half the global supply of used plastic, metals, and waste paper. At last, Beijing decided that this waste's impact on China's environment and public health was too great, largely because of hazardous waste mixed in with the usable waste, as well as the increasing cost of labor to sort it. So the waste ban (officially called the "National Sword") was put into effect, blocking the import of 24 waste types, including plastics that are low value or hard to recycle.

China took in so much of this waste from the West that, when combined with e-waste, it had become the "world's garbage dump" in the eyes of the Chinese government. As the country grew wealthier, there was little appeal in sorting through dirty, unwanted waste for recyclable and financially valuable materials. So if it was no longer profitable, what would China gain by continuing to take the West's waste? Frankly, not much.

**With that in mind, we have new and urgent questions:**

**What about that waste that's no longer shipped to China? Where does it go now?**

## Plastics require nearly as much, and sometimes more, energy to recycle as it did to produce them in the first place.

The fact is that the alternative for recycling companies in Western nations is grim, particularly for plastic. Currently, there is no viable alternative to process it all. Other countries (many of them also in Asia) accept these recyclables, but they don't have the capacity to process the vast volumes previously shipped to China. As Western companies and municipalities struggle to find a solution, many recyclables have been either stockpiled in rented warehouses, incinerated, or sent off to a landfill, defeating the whole purpose of recycling.

So the longer we go without a solution, the larger the waste piles become, the more toxins leak into our air, and the bigger our landfills grow with materials that don't belong there. According to a University of Georgia study published last summer, the amount of waste diverted from China because of this ban will be somewhere near 111 million tons of plastic by 2030. So China's decision, while entirely justifiable in the context of its own national interest, has shone a light on the fundamental flaws of the global waste management system.

Plastic waste import to China began in earnest in the early 1990s, when markets for plastic trash began to open up. Despite the advent of waste recycling among environmentalists in the 1970s, very little infrastructure was built to actually perform recycling for plastic in the United States and other developed countries. It might seem that it would have been more logical simply to build this infrastructure instead of shipping everything in our recycling bins across the Pacific Ocean, but recycling isn't exactly simple to do. It requires significant investments of energy and time, both of which cost money. For countries like ours, it turned out to be more economical to send waste abroad, to developing countries desperate for materials and equipped with cheap labor. And because China

was initially so happy to take trash, that nation ended up collecting nearly half of the world's used plastic for three decades between 1988 and 2017.

An economist might recognize this as a case of developed countries imposing the negative externalities of waste on China. "Whenever you buy something, supposedly you're paying for the pollution costs so that the company can properly manage its waste since they have to pay money to do that," explains Jim Puckett, an economist and the director of the Basel Action Network, a global waste watchdog group. In an ideal economy, the cost we pay for any item would include the cost the company should pay to manage its waste and environmental effects. But in our current economic system, Puckett contends, this isn't the case: "It's so easy now to just send off your problems to other parts of the world that are not able to send you a bill."

Ultimately, a global industry that relies on imposing negative externalities on millions of people in developing countries is not moral or sustainable, even if it has been profitable. However, there are a whole host of other reasons that global waste management — particularly of plastic — is not sustainable. For one, plastics require nearly as much, and sometimes more, energy to recycle as it did to produce them in the first place.

First and foremost, we misunderstand the role we as consumers play in recycling, explains Joy Scrogum, Sustainability Specialist at the Illinois Sustainable Technology Center (ISTC, a Division of the Prairie Research Institute). "It is a misnomer to say, 'I recycle,' when you put your paper in the office collection bin or put your bottles and cans out to the curb in a separate bin. You're not recycling when you do that, you're separating materials for recycling."

Prior to Jan. 1, 2018, almost all household recyclables were traveling thousands of miles across the Pacific ocean to be processed in China. This map shows the tremendous distance a recyclable would need to cover to reach a facility to be processed.

**7,156 MILES**

URBANA, ILL.

SHANGHAI, CHINA





**It is estimated that Coca-Cola produces 110 billion plastic bottles a year. This is about 15 bottles per person on this planet, making a Coke bottle one of the most common in the recycling stream.**

Too many people think that by just dropping their trash into the recycling they have prevented every environmental damage associated with it. Even before China's waste ban, not everything deposited in recycling bins was actually recycled, largely due to user errors. As it currently stands, there is no guarantee that your recycling will reach a processing facility instead of a landfill or incinerator.

Furthermore, even if 100% of people sorted 100% of their recyclables 100% of the time, it's not helpful if all these products were made out of virgin materials that will run out eventually without careful management.

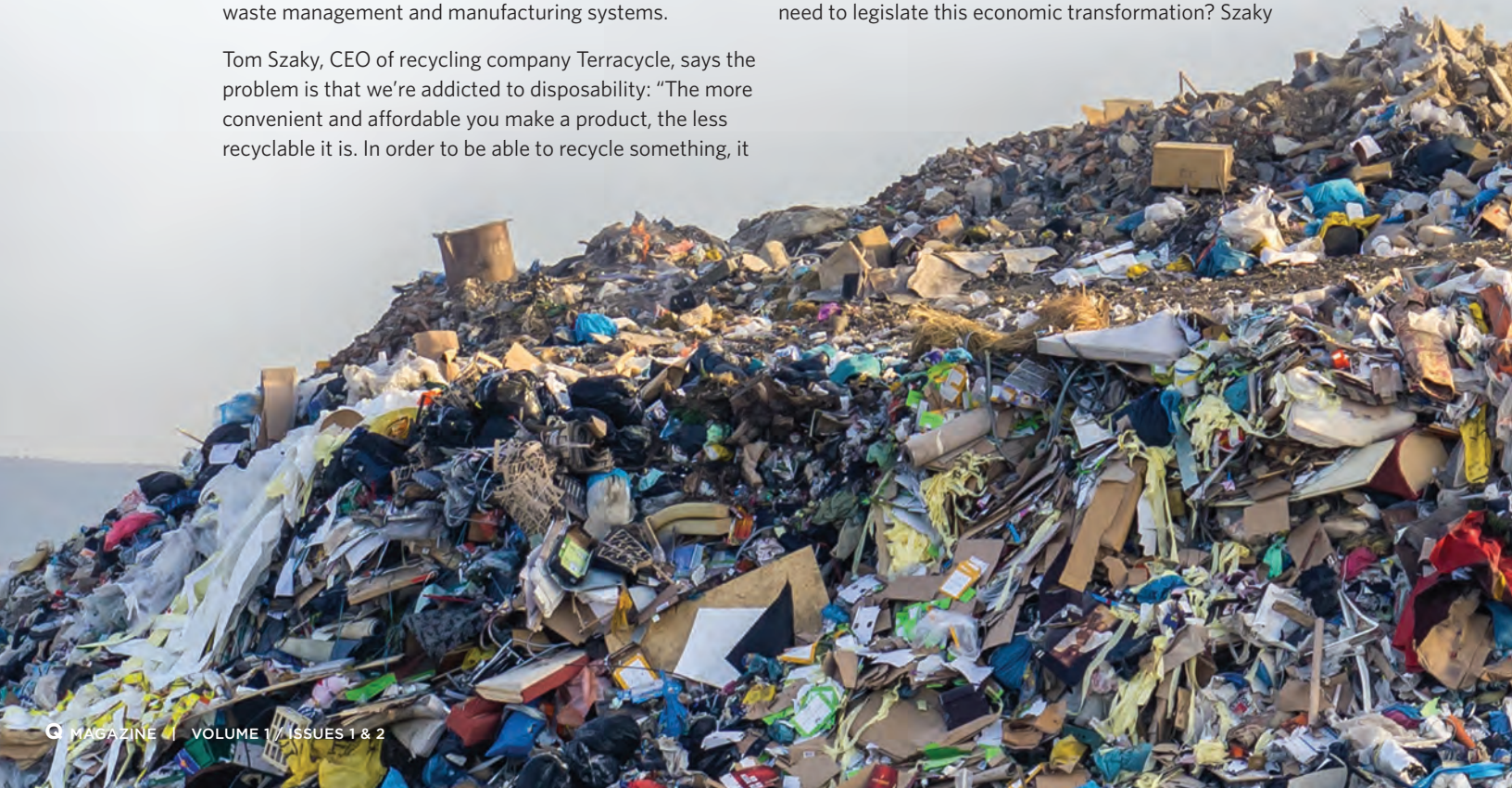
"The loop isn't effectively closed until you're buying materials made with post-consumer recycled content," Scrogum says. In other words, we're going to need a whole lot more of our products to be made out of recycled content to make recycling a truly effective part of our waste management and manufacturing systems.

Tom Szaky, CEO of recycling company Terracycle, says the problem is that we're addicted to disposability: "The more convenient and affordable you make a product, the less recyclable it is. In order to be able to recycle something, it

needs to be economically feasible. So even if you have the infrastructure, if you're going to lose money doing it, you won't recycle."

Though the word "disposable" instantly calls to mind food packaging from supermarkets or fast food joints, it also applies to the reusable items that we either break or grow tired of and then want off our hands. As long as we keep producing and throwing away stuff, we will continue to have a host of problems on our hands: pollution in both manufacturing and disposal; growing landfills; heightened energy demands; depleting stocks of raw materials and resources; and the externalities all of these things produce. Even if we built enough recycling facilities in the United States to process every bit of plastic we sort for recycling, it would still allow us to keep disposing of waste wantonly. We would still suck up resources and energy in producing and recycling the materials. The recycling of plastics would still be dirty. Trash would still get burned. Because of these baseline conditions, Puckett believes that, eventually, "the world will realize [recycling] is largely a joke."

So while we need a greater capacity to recycle things in the U.S. and other developed countries, we cannot let ourselves believe it alone will solve the waste problem. Only overcoming our culture of disposability can do that. That's a tall order to be sure: No one wants to give up the convenience and affordability of disposable goods. Given that, Szaky says, "we need to create economic models where we move away from disposability. ... That is really the most important part. Companies and entrepreneurs need to invent and develop these models." Do politicians need to legislate this economic transformation? Szaky



suggests it's probably better to start with companies and businesses themselves, which can clear the way for politicians to amplify their efforts through law later on.

Meanwhile, Puckett argues we need a more universal, democratic system to deal with our waste crisis. He describes six steps, foremost of which is to ban single-use plastics. His other suggestions range from incentivizing against other unnecessary and toxic plastics, continuing anti-plastic promotion to the public, monitoring developments in the global waste management system, and placing plastics under the Basel Convention. It's this last point that is making the most progress. The Basel Convention, established in 1989 to regulate the trade and disposal of hazardous waste, might be on the verge of a significant amendment, Puckett says. In the wake of China's waste ban, Norway proposed adding multiple polymer plastics to Annex II of the Convention, which covers technically non-hazardous wastes that still warrant special consideration.


If passed, Annex II would become effective within a few months of signing, and the changes would be immediate, he says. Because the U.S. did not sign the Basel Convention, it would no longer be able to export plastic waste to developing countries; and European plastic exports will also be banned since Annex II lies within the convention requirements. Importing countries would need to approve any shipments of plastic waste, increasing transparency.

"The net effect of all of this," Puckett says, "would be far less movement of plastic wastes globally, and countries would have to do what the Basel Convention aimed for since the beginning: national self-sufficiency in waste management."

**There's a new term for the kind of system that would achieve this self-sufficiency: the circular economy.** It's become something of a buzzword in environmental circles recently, though it's not necessarily the easiest term to define. Says University of Illinois resource economist Don Fullerton: "I don't know what the circular economy is, because somebody made it up, and it's a label that's used in many different ways by different people for different purposes."

What Fullerton makes clear is that whatever this system is, it uses less extraction and less landfilling. To those advocating for this kind of economy, our current economic system is "linear." In this linear system, most materials are extracted from the earth, manufactured into a product, sold to consumers, used and then disposed of. This linearity is what allows the buildup of waste and landfills at the end of the line. In a circular economy, by contrast, the end of the line is looped back to the beginning as often as possible. According to the Ellen MacArthur Foundation, the leading nonprofit working to circularize the economy, the system has three main principles: designing out waste and pollution; keeping products and materials in use; and regenerating natural systems.

"We need to change our mind-sets in terms of our place in the natural world and our relationship with resources," Scrogum says. "That's what is needed to create a circular economy."



Due to the chronically low rate of plastic recycling in America, plastic bottles proliferate in our landfills. There, they will never fully decompose, and leach toxic chemicals in the ground. Credit: Shutterstock



**"We need to change our mind-sets in terms of our place in the natural world and our relationship with resources. That's what is needed to create a circular economy."**

**Joy Scrogum**, Sustainability Specialist at the Illinois Sustainable Technology Center



“We need to be able to look forward with optimism and joy to a long future in which humans flourish along with other forms of life that are part of the ecosystems in which we live. **Are we able to live on Earth without ruining it?**”

**Robert McKim**, Emeritus Professor of Religion at Illinois



Credit: Shutterstock

In other words, we need to be willing to make the sacrifice. We can look for ways to hold onto the convenience of disposability, but it doesn't seem likely we can enjoy them without creating more mountains of waste and irreversibly depleting our natural resources. For a species that has engineered its way to the moon, creating alternatives for single-use plastic (or at the very least the capability to recycle plastics cleanly) should be within our reach.

We're taking some steps in the right direction. Early last year, a supermarket in the Netherlands made headlines for introducing the first plastic-free grocery aisle in the world. Right here at the University of Illinois, the iMBA program helped student Chris Moriarity create the Million Waves Project, which collects plastic litter from beaches and puts it through 3D printers to create prosthetic limbs. Though this project doesn't abate the production of plastic waste, it showcases the kind of inventive thinking and ingenuity needed to create a world with less of it.

Ultimately, though, it will take much more than a smattering of technological and infrastructural advancements, or adding plastic to the Basel Convention, to adequately address our waste epidemic. No one interviewed for this article was particularly optimistic that the U.S. is going to garner the will to transition our waste management system to a more sustainable platform very soon — especially not to prevent the 111 million tons of waste no longer welcome in China from going unrecycled by 2030. Until we can circularize our economy, we will remain awash in waste.

In the end, it's not just about our trash, but our entire future and purpose as a species. “We need to be able to look forward with optimism and joy to a long future in which humans flourish along with other forms of life that are part of the ecosystems in which we live,” says Robert McKim, emeritus professor of religion at Illinois. “Are we able to live on Earth without ruining it?”

Right now, the signs seem to point to no. Cheap disposable goods have made life significantly more comfortable and convenient in wealthy countries for several generations, making them hard to give up. But we're now at a crossroads. We're choking on waste — and will soon drown in it. Avoiding that fate for us and our children is doable; we just have to recycle our willpower, over and over, to make it happen.



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She graduated in May 2018 with a B.S. in Environmental Sustainability and a minor in Integrative Biology. She was a staff writer for the *Green Observer* magazine for three years.





# paradise

## REGAINED

By Mallory Shaw

As my dad and my childhood self descend the bluff, the trees on either side of the road break and we gaze upon the vast expanse of cornfields. A tractor sits crooked, its back wheel sunk deep in the mud. A large puddle covers the far portion of the cornfield, transforming it into a lake. I am full of questions: "How are they going to get that out? Why do they plant fields where it floods all the time?"

"This used to be a lake," Dad explains to me. "They drained the water out to plant crops. But the water still naturally wants to go there."

The place in the Illinois River Valley where "the water naturally wants to go" is now known as Emiquon National Wildlife Refuge. Since that day so many years ago, the fu-

tility of fighting nature has been realized, and the wetland has been restored.

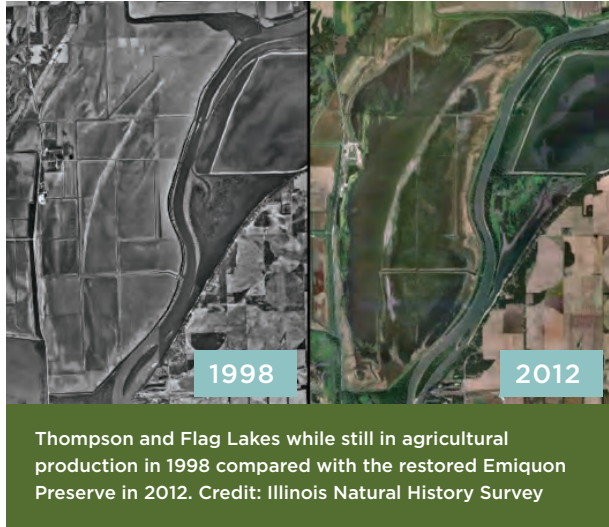
When European settlement of North America began in the 1600s, many settlers viewed wetlands as wastelands because they impeded travel and couldn't be farmed. Drainage became the signature of westward expansion. But the truth is, the uses we get out of wetlands are extremely important. And once gone, bringing a wetland back to life is a challenging and complex task.

My family often drove past the Emiquon area on our vacations. Think of your own travels. What do you look for when you need to stop? Most people would look for a place that is clean and safe with plenty of food. Animals are the same way. They have certain basic needs, and



A black-crowned night heron, one of the 260 species of birds that have been observed at Emiquon since its restoration in 2007. Credit: Shutterstock

*The restored Emiquon serves as a crucial ecological niche and waystation. It supports roughly 70% of waterfowl that migrate through the Illinois River Valley and more than 20 endangered bird species — a feat earning it the designation as a Ramsar Wetland of International Importance.*



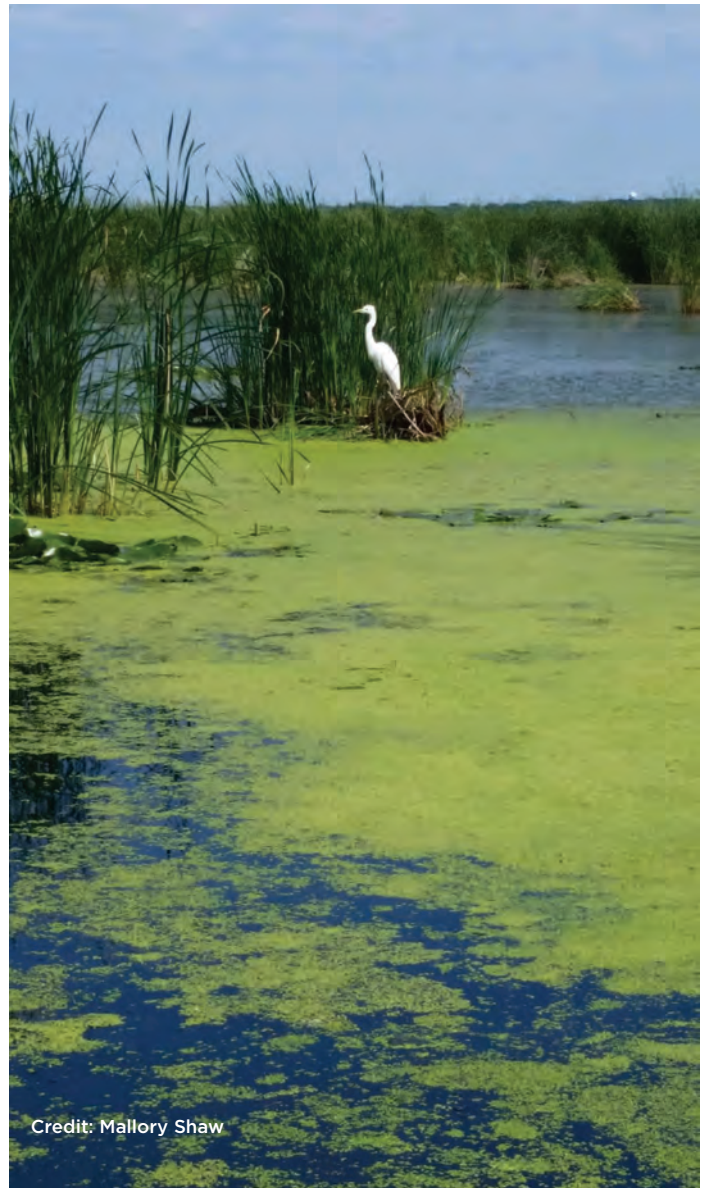
healthy wetlands are desirable resting places — a necessity even — for numerous species, many of which are endangered. Consider the plethora of birds that migrate each year. They embark on taxing journeys, traveling hundreds or thousands of miles to reach favorable climates, breeding grounds, and resource-rich habitats. Along the Illinois and Mississippi Rivers, including Emiquon, numerous bird species can be spotted luxuriating in the bounty of wetlands. In winter months, bald eagles can be seen in large numbers. Waterfowl and coots abound. In the summer, one can expect to see hundreds of pelicans, scores of terns and gulls, a variety of herons, and slews of different shorebirds in addition to the many songbirds and birds of prey.

While some birds simply pass through wetlands, others seek them as breeding grounds. Since its restoration began in 2007, more than 260 species of birds have been observed at Emiquon. In fact, Emiquon is listed as a hotspot on e-bird (a monitoring app popular among birders), making the spot a popular destination for nature lovers, as some of the birds are rare. Some species found nesting on the refuge include black-crowned night herons, least bitterns, and common gallinules. Many of these birds have become uncommon sights in Illinois, mainly due to a loss of their habitat.

The restored Emiquon thus serves as a crucial ecological niche and waystation. It supports more than 2% of the

country's American coot population (and more than 1% of the global population), roughly 70% of waterfowl that migrate through the Illinois River Valley and more than 20 endangered bird species — a feat earning it the designation as a Ramsar Wetland of International Importance. And birds aren't the only creatures to call the Emiquon home: 35 species of fish have been stocked in its waters, and a wide assortment of invertebrates, insects, amphibians, reptiles, and mammals also play a part in this bustling ecosystem.

What about the benefits of wetlands to us? While so many wildlife creatures make wetlands their homes, the wetlands themselves are protecting our homes from flooding. Imagine a river. When excess water is poured into the river, it will overflow its banks. Wetlands provide a place for that excess water to go. The vegetation slows



Credit: Mallory Shaw



Credit: Mallory Shaw



Credit: Mallory Shaw



Credit: Mallory Shaw

the flow of the water, lessening the destructive impact. The water then stays in the wetlands and drains at a significantly slower rate. Nature's sponge would be a good way to picture it.

But development has degraded that sponge effect. Draining wetlands involves the drastic alteration of free-flowing waterscapes by erecting levees, installing drainage ditches and pump systems. Historically, hardwood wetlands could once store about two months' worth of flood waters, but their decline now only sees about 12 days worth of flood water stored. Worse still, when levees disconnect the river from the wetland, the result is catastrophic flooding. After the levee district at Thompson Lake was finished, high water levels in the river led to more frequent flooding of Havana (the town across the river from Emiquon). Citizens could be heard grumbling about "dynamiting the levee" as a result.

The advantages of wetlands have not always been recognized, and the Illinois River Valley bottomlands were no exception. Emiquon was historically composed of two lakes, Thompson and Flagg, which were drained in 1923. Prior to being depleted, Thompson Lake boasted being the largest, most productive bottomland lake in the Illinois River Valley. Wildlife was so abundant that people could make a living just from hunting and fishing. In the late 1800s to early 1900s, hunters and fishermen flocked to the area for its seemingly endless abundance of fish and waterfowl, gaining a reputation among outdoorsmen as the "inland fishing capital of the world." It comes as no surprise then, given the size of the lakes and their rich history, how much life was lost when draining took place. Records show that as the lake was draining, 600,000 pounds of fish were pulled from the water while more than twice that amount died. The loss was only one of many that has contributed to the destruction of greater than 90% of the state's wetlands. The wetland-turned-farm produced rice, corn, soybeans, tomatoes, and cattle for 83 years until the Nature Conservancy purchased it in 2007.

Restoring a wetland to its former glory is a highly complex undertaking that takes years to accomplish. Just as the Greek philosopher Heraclitus observed it is impossible to step into the same stream twice, it is also impossible to restore a wetland to its "original" state with exactly

*Refuges like the Emiquon offer a glittering example of how to accomplish conservation goals and create sustainable futures for both ourselves and the multitude of creatures who call Illinois home (at least part-time).*

the same composition of species, soil complexes, water levels, and nutrients. One of the many challenges facing restorations of any kind is that of invasive species as the climate changes and people, unwitting couriers of invasives, become more mobile. When trying to restore an ecosystem, managers need a plan to deal with invasive species already present, to prevent them from spreading, and to prevent new invasives from becoming established.

Perhaps the most infamous invasive fish, the Asian carp, has made its way into the Emiquon refuge with the flooding of the Illinois River breaching the levee twice in the past 11 years. Plants are no less destructive. Invasive plants earn their name by crowding out native species to create monocultures. Purple loosestrife, phragmites, and curly leaf pondweed are some problematic plants found at Emiquon. Thriving in the face of disturbance, blooming early, and even growing a second time after spring cutting, reed canary grass is an especially troublesome invasive. Removal of an invasive species can take an exceptionally long time, if it can ever be done at all.

Today, I drive by the area I remember as dismal flooded fields. As I descend the bluff, water glistens in the sun for miles like millions of little diamonds strewn loose. Birds of all sorts fly about, and fish flip their tails as if to say you can't catch me! The devastation done to our wetland ecosystems during the past 150 years can no longer be ignored. So much natural habitat has been destroyed that we can't be satisfied with simply protecting the little that remains. Restoration is an absolute must! Refuges like the Emiquon offer a glittering example of how to accomplish conservation goals and create sustainable futures for both ourselves and the multitude of creatures who call Illinois home (at least part-time). As the waters of the Emiquon glint in the sun, so the entire refuge shines like a northern star, guiding us toward nature's revitalization and our role in ensuring it.



Mallory Shaw lives in Bloomington, Ill., with her husband and son. She's a senior Natural Resources and Environmental Sciences major concentrating in fish and wildlife conservation. Her career (and life) goals are to restore and protect wetlands — and the wildlife dependent on them.



GETTING TO THE

# POINT



Our Favorite Stuff

**I acquired a huge pen collection in middle school. From the earliest days of sixth grade, I noticed my classmates' habit of abandoning writing instruments all over the hallways and classrooms. Ever-motivated by the allure of free stuff, I began filling my pencil case with an endless supply of orphaned Bics and Ticonderogas.**

By Zack Fishman

Of course, I didn't need dozens of pens to complete my homework, but I saw unrealized utility in every forgotten writing tool. I couldn't understand why people thought nothing of losing pens in good condition, on a near-daily basis. Soon my overflowing collection had to be bound by rubber bands to stay together. Only years later as a college student studying sustainability did I come to research the problem of disposable pens — and discover its true scale.

The rescued pens of my youth comprise a mere drop in the inkwell of global annual pen sales, which number at least 5.5 billion. A technology that traces back to the ancient Egyptians many millennia ago, pens are now cheap, ubiquitous objects that invade countless schools and offices.

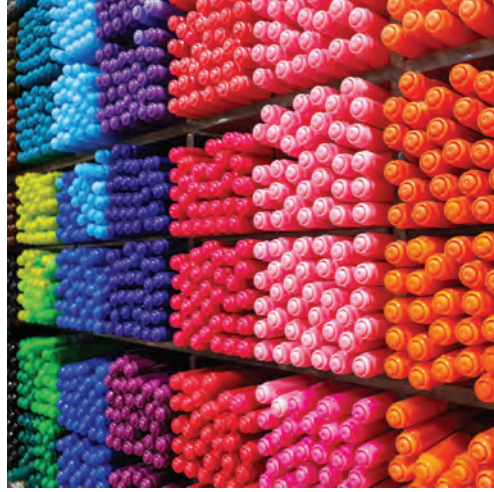
To disassemble the pen supply chain, we begin with the ink, a concoction of dyes and solvents. Its common ingredients are water, alcohols, carbon black, glycerides, and polyvinyl compounds. Carbon black in particular, responsible for the deep black color of most pens, is the most hazardous ingredient because it is produced by

burning tar, a process that releases carbon dioxide and many other pollutants.

The ball bearing in the tip of the average pen is made of a tungsten compound. This metal is mined primarily in China and Russia but also in the Democratic Republic of the Congo — the latter devastated by civil war, fueled in turn by the sales of tungsten and other valuable resources. Government and rebel armies fight for control of the mines and force citizens to work long shifts in crippling conditions. Put simply, our demand for an endless supply of pens feeds human rights abuses and war in Africa.

The point that holds the ball of the ballpoint pen is made of brass, a copper alloy, whose mining poses its own environmental hazards. Access to copper is only made possible by open-pit mines, where massive layers of rocky earth are stripped away and processed for the valuable ore. Extraordinary amounts of water and fossil fuels are expended for this extraction. Copper mining causes "Black Lung" in miners and pollutes adjacent rivers with acidic wastewater.

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Lyndon B. Johnson borrows a pen from Harry Truman. Credit: Wikipedia

The pen body and cap of a disposable pen are, of course, plastic — a material shaped from crude oil. This oil is extracted by injecting water or gas into the earth to propel the black gold to the surface. The extraction process alone threatens host ecosystems with oil spills and contamination. And the subsequent industrial process that turns the oil into plastic releases chlorofluorocarbons, an extremely potent greenhouse gas.

After their extraction, petroleum and its byproducts are shipped across the world to factories where 170 pens per second are manufactured globally. These gleaming new pens, in their millions, are then transported worldwide to stores and businesses for you, the average consumer, to grab by the handful.

After being purchased, used briefly, chewed and forgotten, the pen is discarded either in a bin or as litter. Whether transported by a fleet of garbage trucks or trodden into a patch of dirt, the pen will persist in the environment for centuries. On timescales a thousand times longer than its evanescent period of use, the disposable pen is always with us, leaching toxins into surrounding soil and wildlife.

Behind every step in the pen's life cycle lies an enormous consumption of water, fuel, and cheap labor. In the extraction, manufacture, and distribution of pens, as with so many of our daily life supplies, we treat Earth's resources as endless in supply, low in cost, and without negative flow-on consequences. The pen industry typifies modern manufacturing in its inherently unsustainable and unjust character.

With these issues pervading pen production, what's an average consumer to do? One alternative is purchasing products that use fewer resources, such as refillable pens that only need the ink replaced or bamboo pens made from sustainable plants. These solutions have limited impact, however; both options still require unsustainable resources to make the other parts of the pens, while the refillables would necessitate a revolutionary attitude adjustment from consumers, who already take advantage of the pen's disposability.

Truly solving the negative externalities of pen production is not as easy as buying the right product; it instead demands fundamental changes to our manufacturing and consumer mindset. Brass will never be made sustainably until open-pit copper mines minimize environmental damage, and tungsten extraction will always involve both environmental and social hazards. In this sense, the problems of pen production exemplify the unsustainability inherent in most other mass-market products. Modern manufacturing mostly involves environmentally and socially exploitative processes, and eliminating these in favor of a sustainable, equitable production infrastructure will be complex and painstaking.

My pen collection prevented only the most visible litter and waste, and nothing I could have done in middle school could prevent the damage caused in the wake of their production. Yet if the environmental damage attributed to the meager pen cannot be prevented, what hope is there for cleaning up the rest of our economy?



Zack Fishman is from Park Ridge, Ill., and received a B.S. in Engineering Physics with a minor in Mathematics and the Certificate in Environmental Writing in May 2019. While at Illinois, he wrote for the *Daily Illini* and the *Green Observer*. He is pursuing a M.S. in Journalism at Northwestern University.

Pictured above, credit: Shutterstock



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